US009165476B2

(12) **United States Patent**
Yoshikawa et al.

(10) **Patent No.: US 9,165,476 B2**
(45) **Date of Patent: Oct. 20, 2015**

(54) **PORTABLE PIANO KEYBOARD COMPUTER**

(71) Applicants: **Yoshinori Yoshikawa**, Los Altos, CA (US); **Keisuke Shingu**, San Francisco, CA (US); **Ryuichiro Kuzuryu**, Sunnyvale, CA (US)

(72) Inventors: **Yoshinori Yoshikawa**, Los Altos, CA (US); **Keisuke Shingu**, San Francisco, CA (US); **Ryuichiro Kuzuryu**, Sunnyvale, CA (US)

(73) Assignee: **Miselu, Inc.**, San Francisco, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/791,335**

(22) Filed: **Mar. 8, 2013**

(65) **Prior Publication Data**

US 2014/0047970 A1 Feb. 20, 2014

Related U.S. Application Data

(60) Provisional application No. 61/609,196, filed on Mar. 9, 2012.

(51) **Int. Cl.**

G10H 1/32	(2006.01)
G10H 3/00	(2006.01)
G09B 15/08	(2006.01)
G10H 7/00	(2006.01)

(52) **U.S. Cl.**

CPC . ***G09B 15/08*** (2013.01); ***G10H 7/00*** (2013.01)

(58) **Field of Classification Search**

CPC G09B 15/08; G09B 15/04; G09B 15/003; G09B 15/006; A01B 12/006; G10H 7/00; G10H 1/0016; G10H 1/0008; G10H 2220/066

USPC ..... 84/464 R, 464 A, 743, 744

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,886,273	A *	3/1999	Haruyama	84/478
6,008,783	A *	12/1999	Kitagawa et al.	345/39
6,025,550	A *	2/2000	Kato	84/464 A
6,087,577	A *	7/2000	Yahata et al.	84/478
6,388,181	B2 *	5/2002	Moe	84/477 R
6,410,836	B2 *	6/2002	Takahashi	84/478
6,821,203	B2 *	11/2004	Suga et al.	463/7
7,030,307	B2 *	4/2006	Wedel	84/477 R
7,247,788	B2 *	7/2007	Lai	84/719
7,390,958	B2 *	6/2008	Knudsen	84/645
7,608,774	B2 *	10/2009	Ohmura et al.	84/470 R
7,853,342	B2 *	12/2010	Redmann	700/94
8,445,767	B2 *	5/2013	Brow et al.	84/609
2008/0078281	A1 *	4/2008	Katsuta	84/609
2013/0068086	A1 *	3/2013	Mittelstadt et al.	84/645

OTHER PUBLICATIONS

"ION, Piano 2 Go, Portable Musical Keyboard for iPod, iPhone and iPad"; Ionaudio.com; 1 page.

Bell, Killian; http://www.macsessed.com/posts/visible-green-usb-cables-from-dexim-visuala-your-charging . . . Feb. 1, 2012; Visible Green USB Cables From Dexim Visualize Your Charging; 2 pages.

* cited by examiner

Primary Examiner — Jeffrey Donels

(74) *Attorney, Agent, or Firm* — Trellis IP Law Group, PC

(57) **ABSTRACT**

A piano keyboard computer includes a piano-type keyboard adjacent to a display screen. The system allows music tutorials, visualizations and other applications. A docking system allows additional devices to be placed on, adjacent to, or near the piano keyboard computer. The additional device then communicates with the piano keyboard computer to add functionality such as additional speakers, controllers, etc. The piano keyboard computer can act as a controller for other devices.

15 Claims, 48 Drawing Sheets

Figure 1

Figure 2

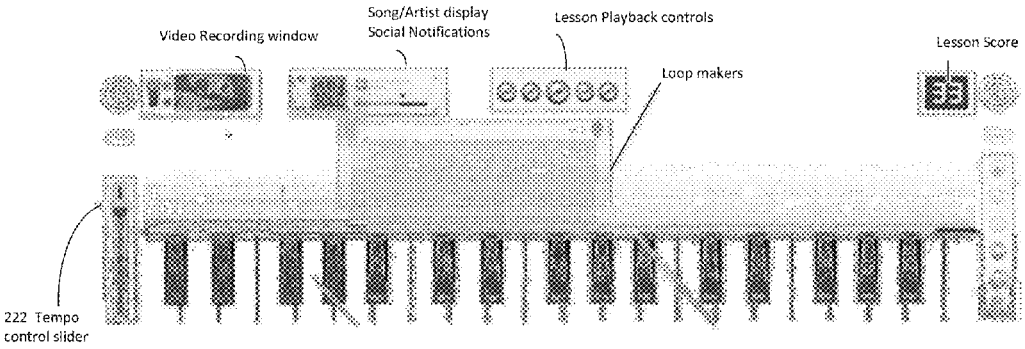

Video Recording window
Song/Artist display
Social Notifications
Lesson Playback controls
Loop makers
Lesson Score
222 Tempo
control slider

Figure 3

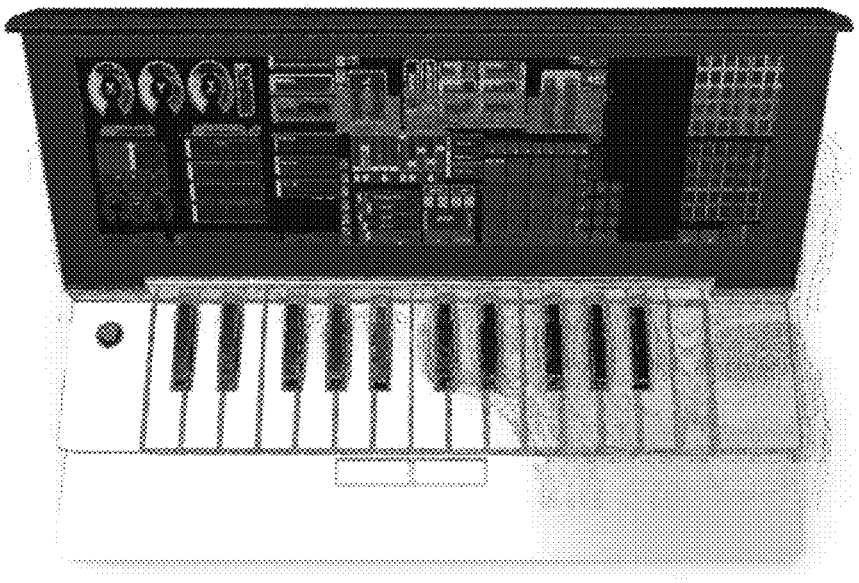


Figure 4

Figure 5

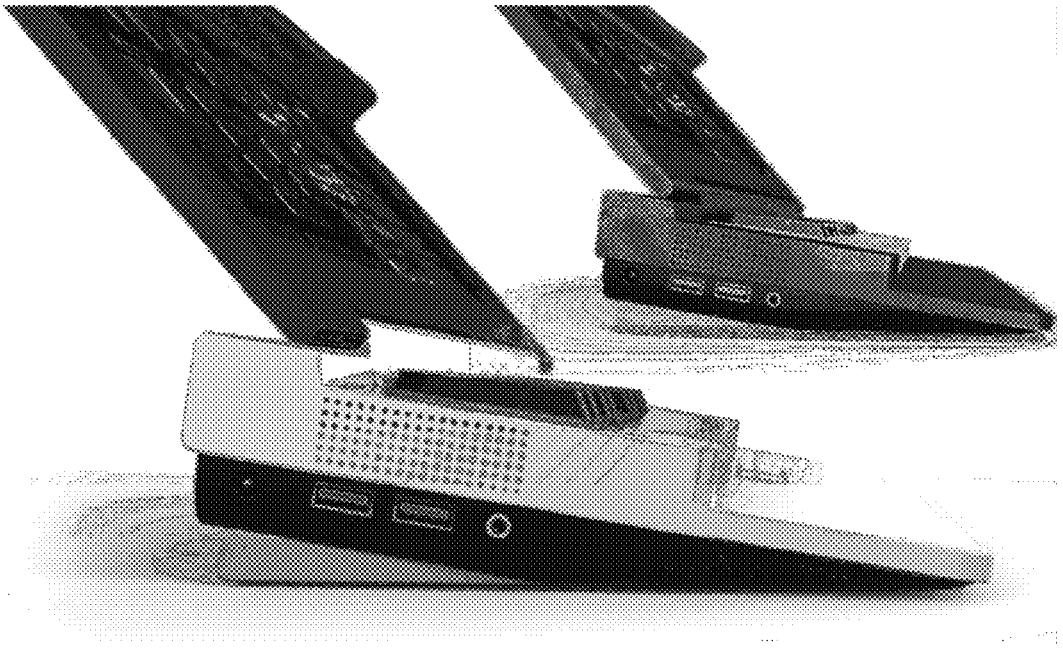


Figure 6

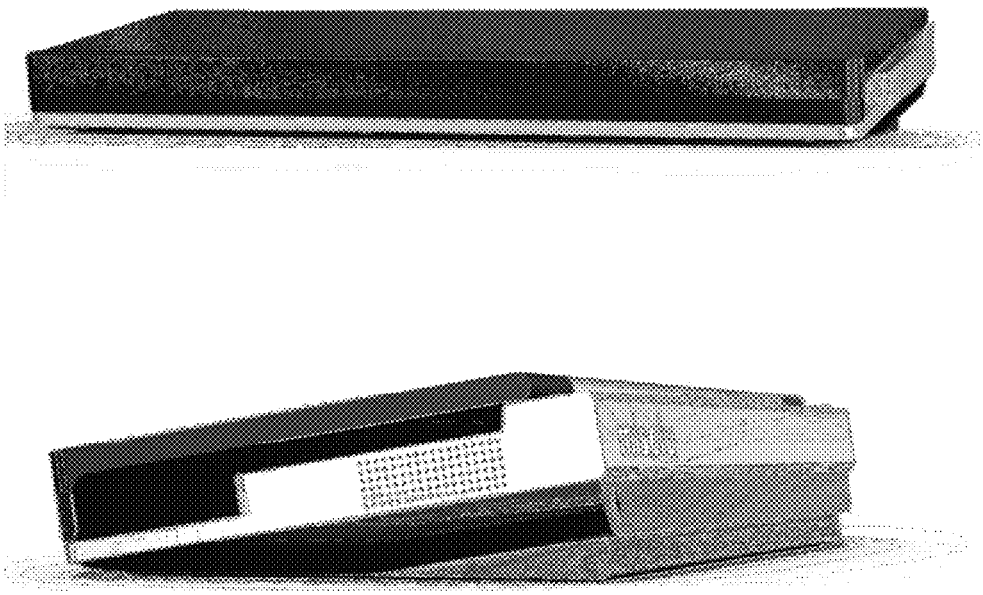


Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

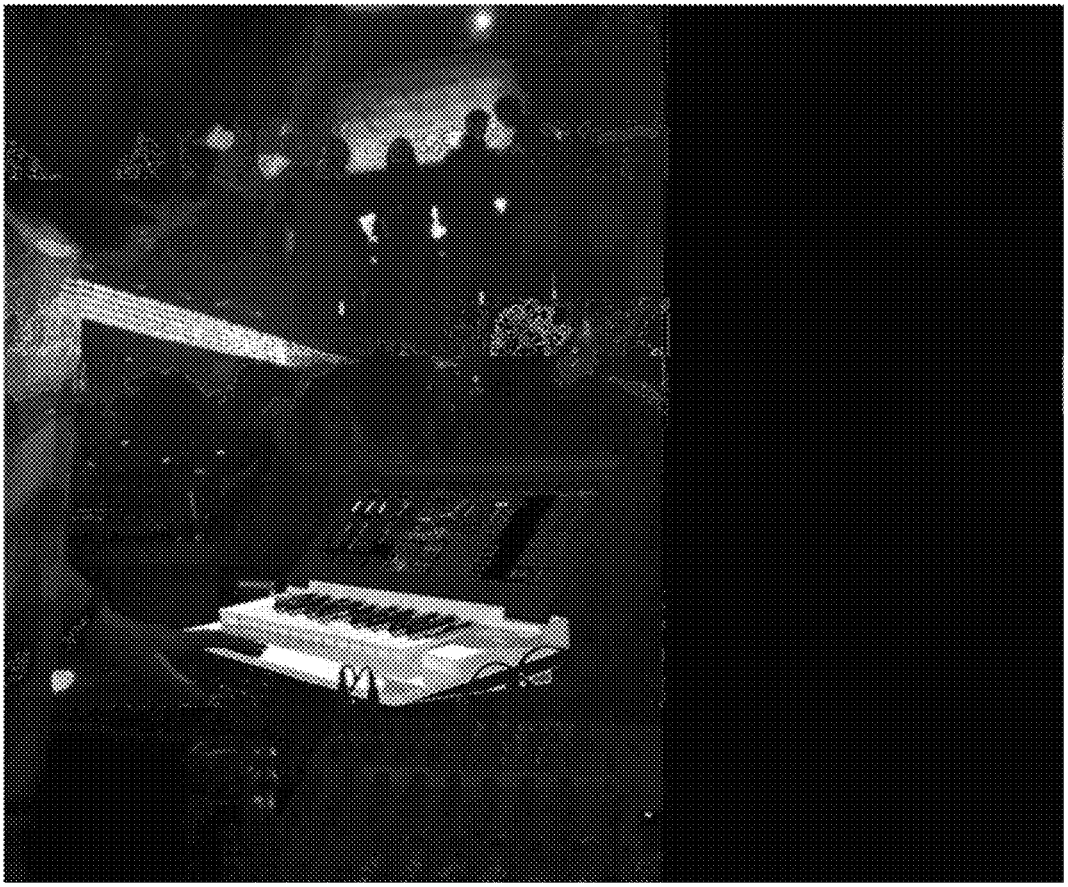


Figure 12

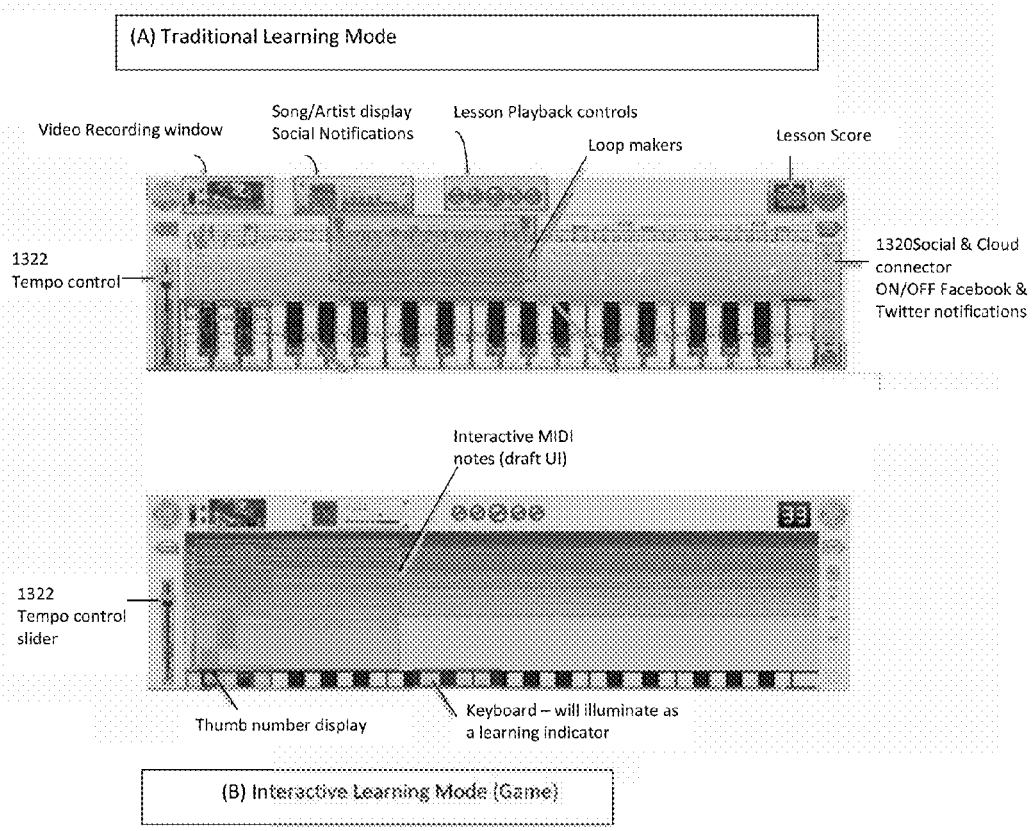

(A) Traditional Learning Mode
Video Recording window
Song/Artist display
Social Notifications
Lesson Playback controls
Loop makers
Lesson Score
1322
Tempo control
1320Social & Cloud
connector
ON/OFF Facebook &
Twitter notifications
Interactive MIDI
notes (draft UI)
1322
Tempo control
slider
Thumb number display
Keyboard – will illuminate as
a learning indicator
(B) Interactive Learning Mode (Game)

Figure 13

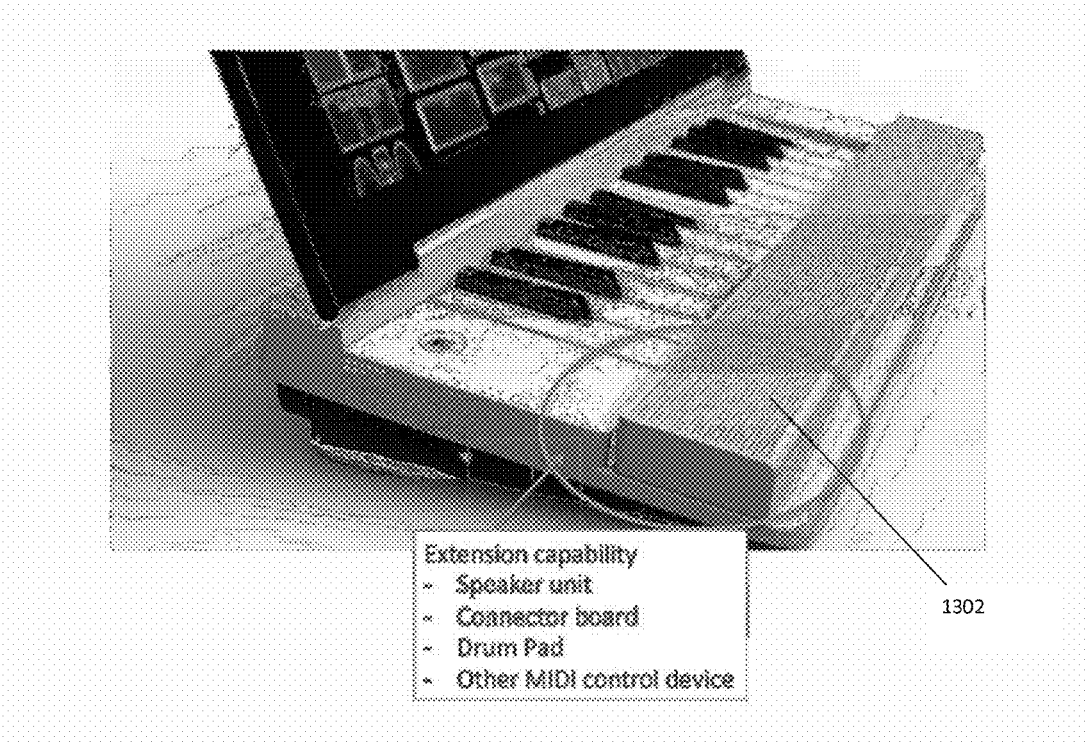

Extension capability
- Speaker unit
- Connector board
- Drum Pad
- Other MIDI control device
1302

Figure 14

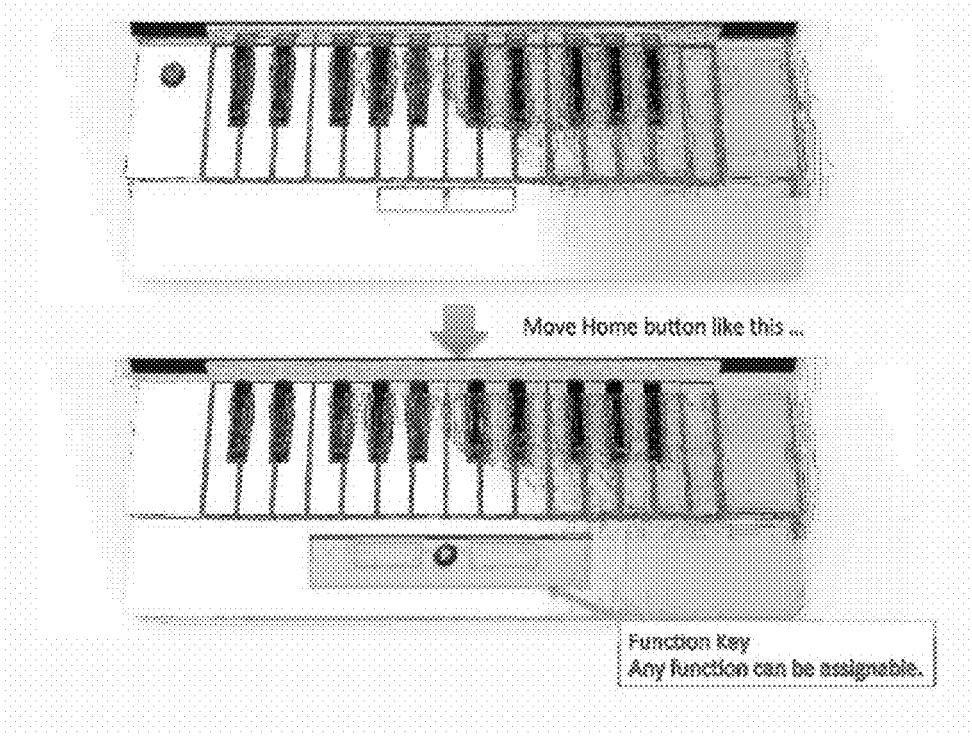

Move Home button like this ...
Function Key
Any function can be assignable.

Figure 15

Figure 16

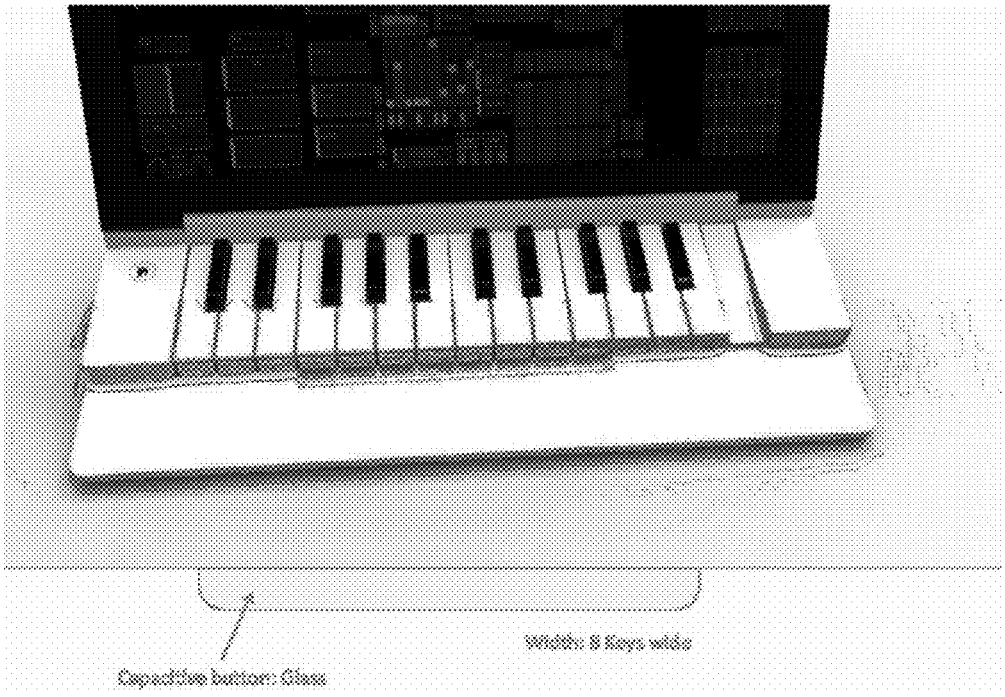


Figure 17

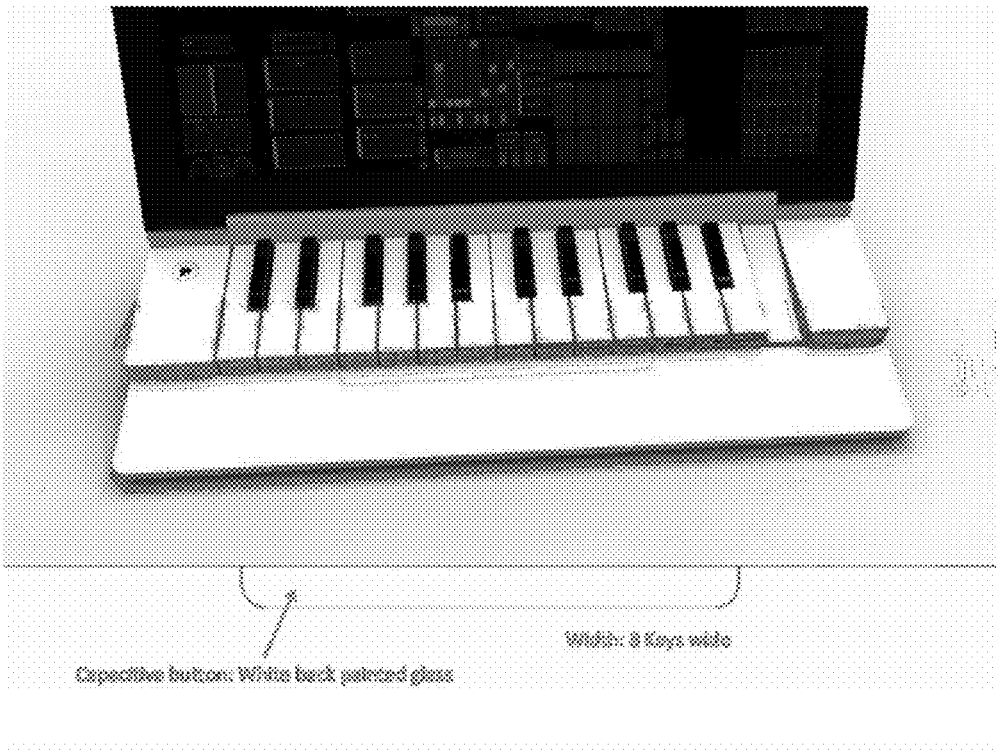

Capacitive button: White back painted glass
Width: 8 Keys wide

Figure 18

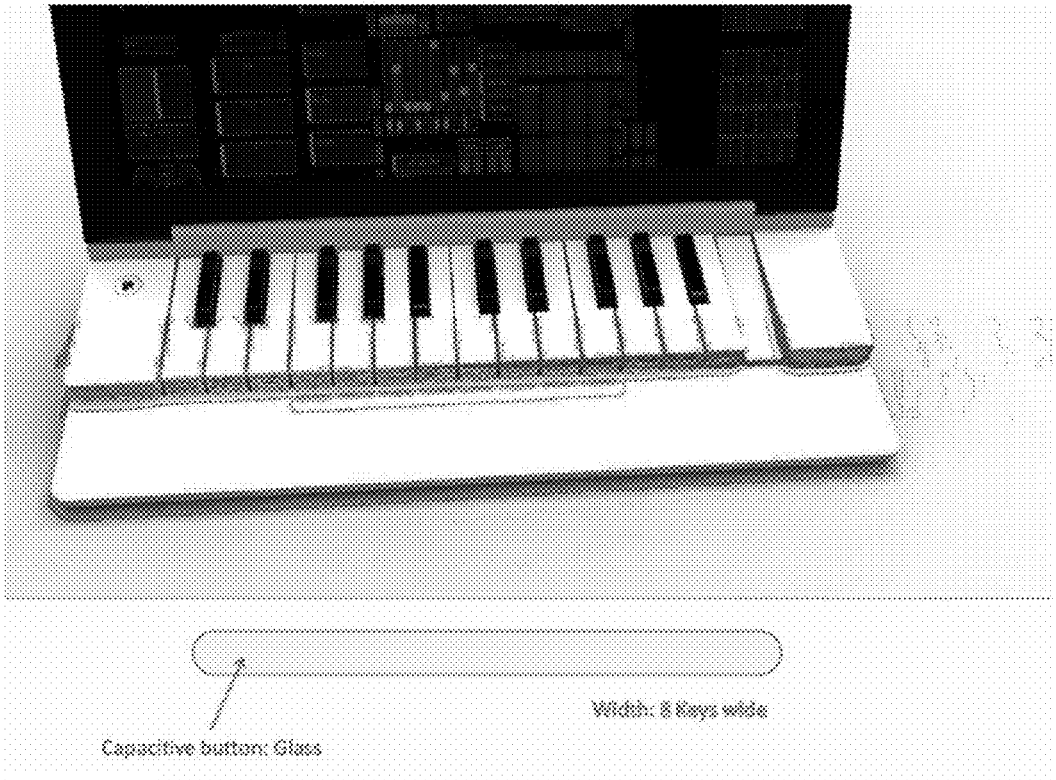


Figure 19

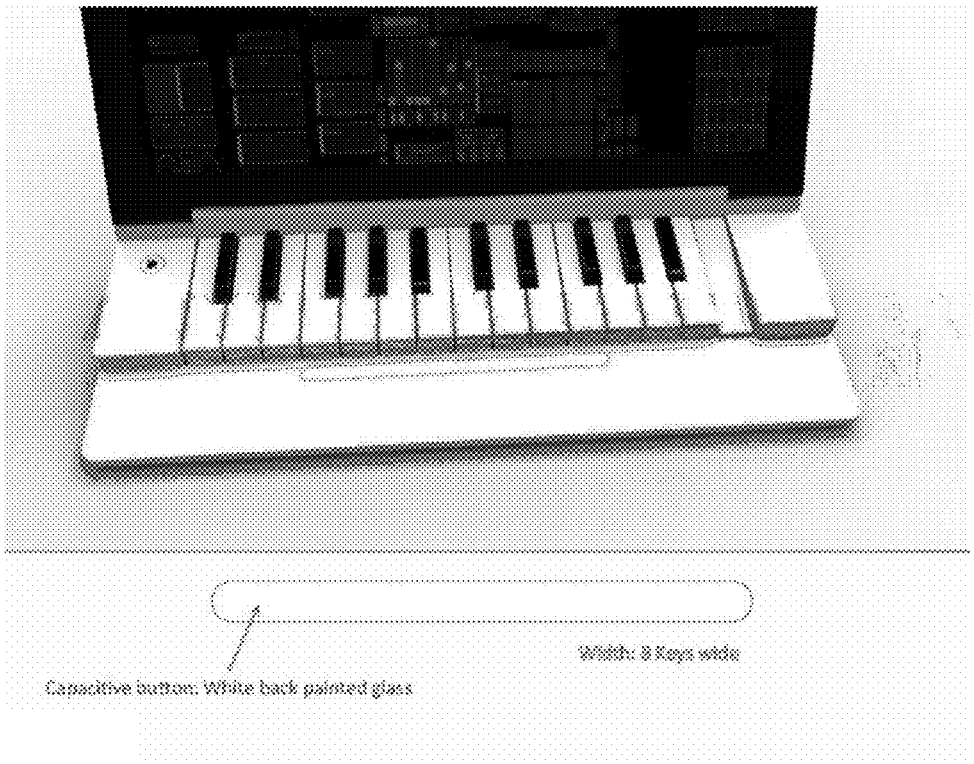

Width: 8 Keys wide
Capacitive button: White back painted glass

Figure 20

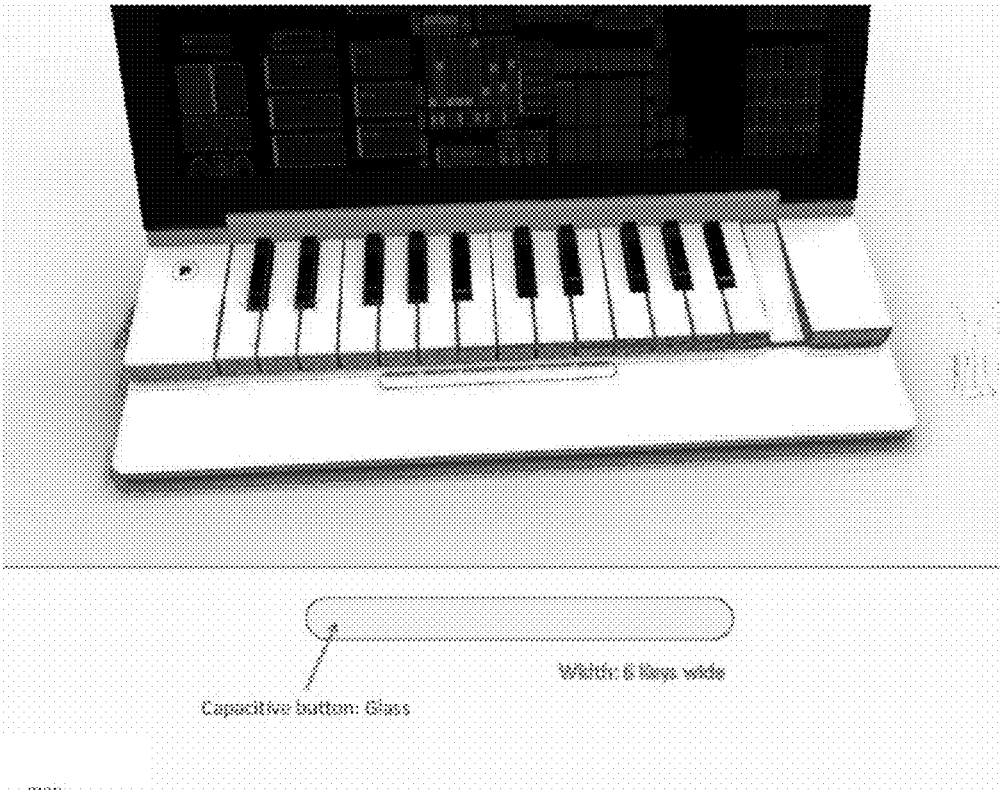


Figure 21

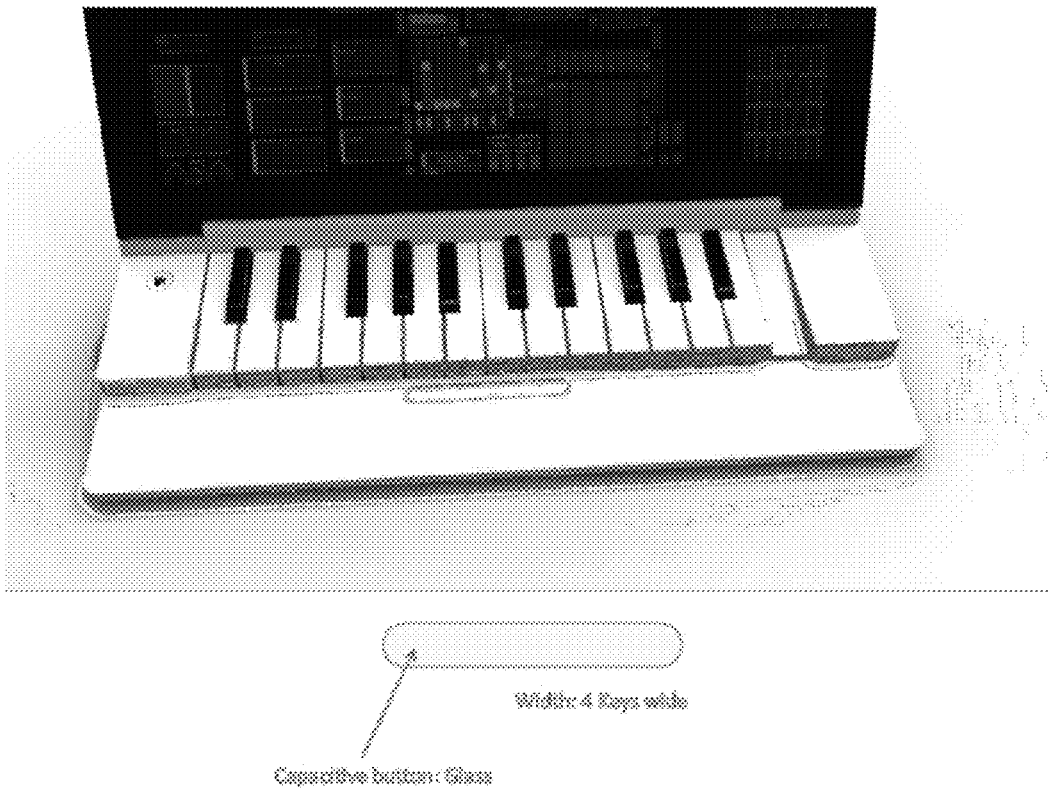


Figure 22

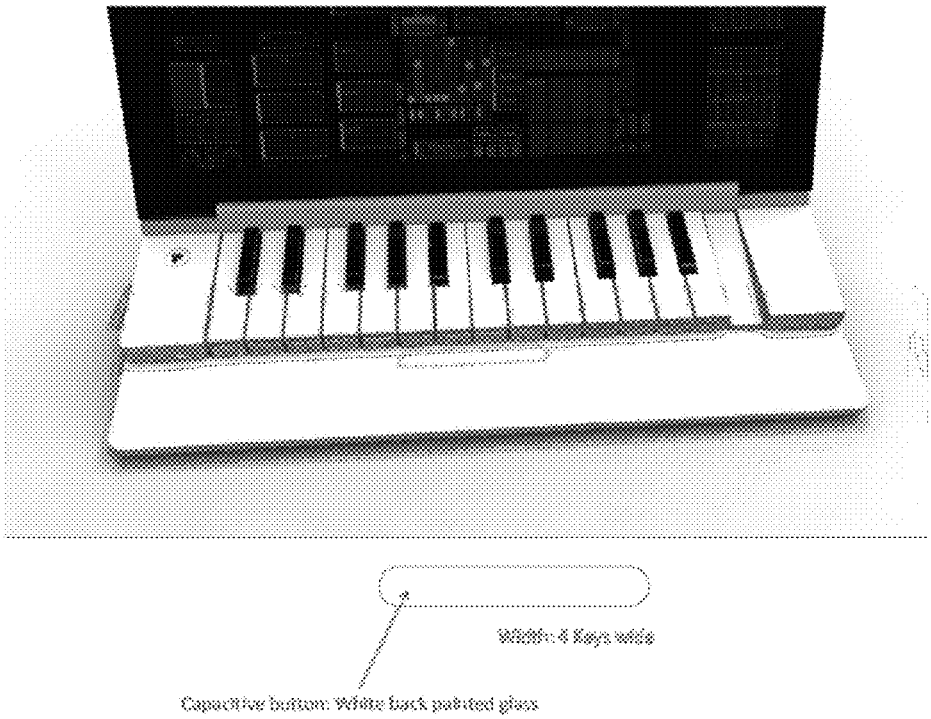

Width: 4 Keys wide
Capacitive button: White back painted glass

Figure 23

Figure 24

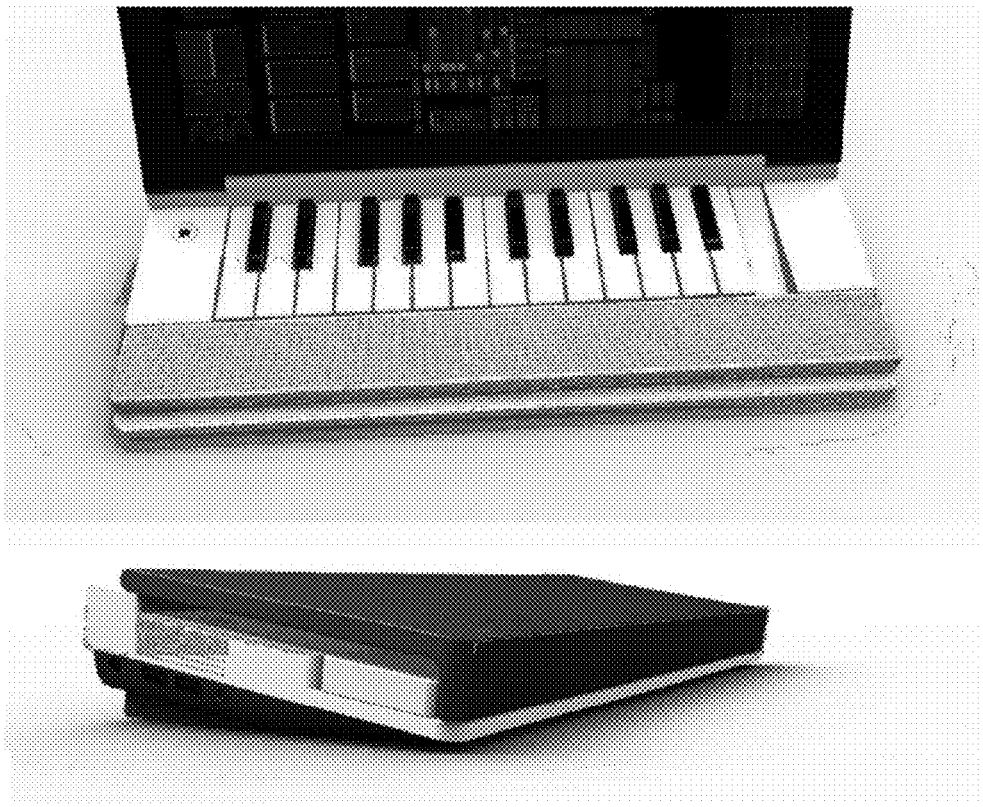


Figure 25

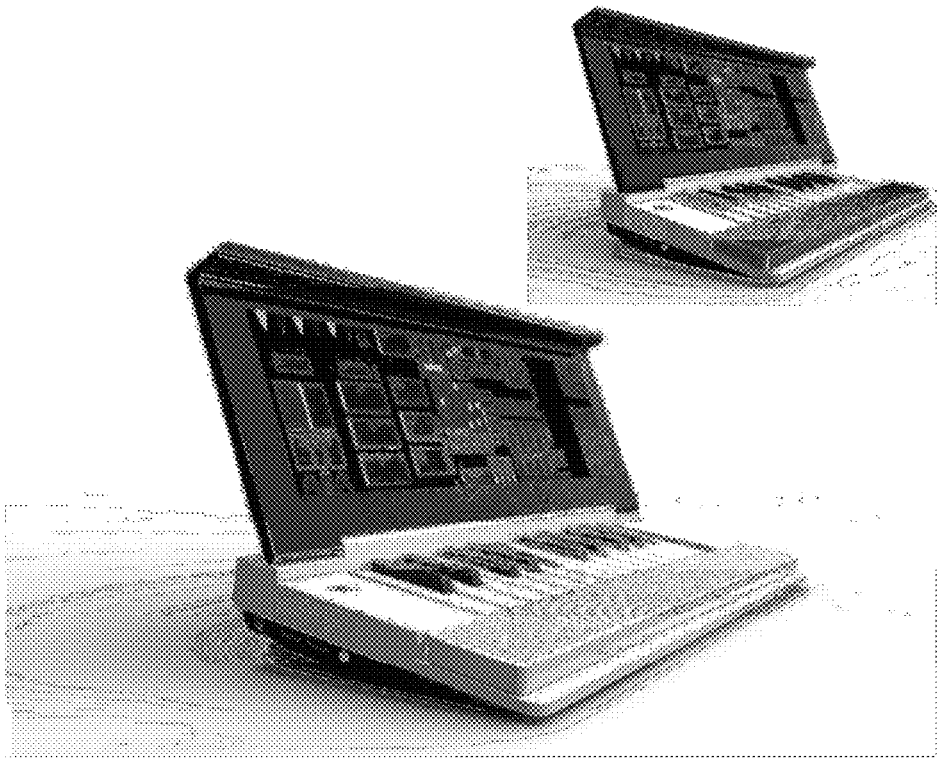


Figure 26

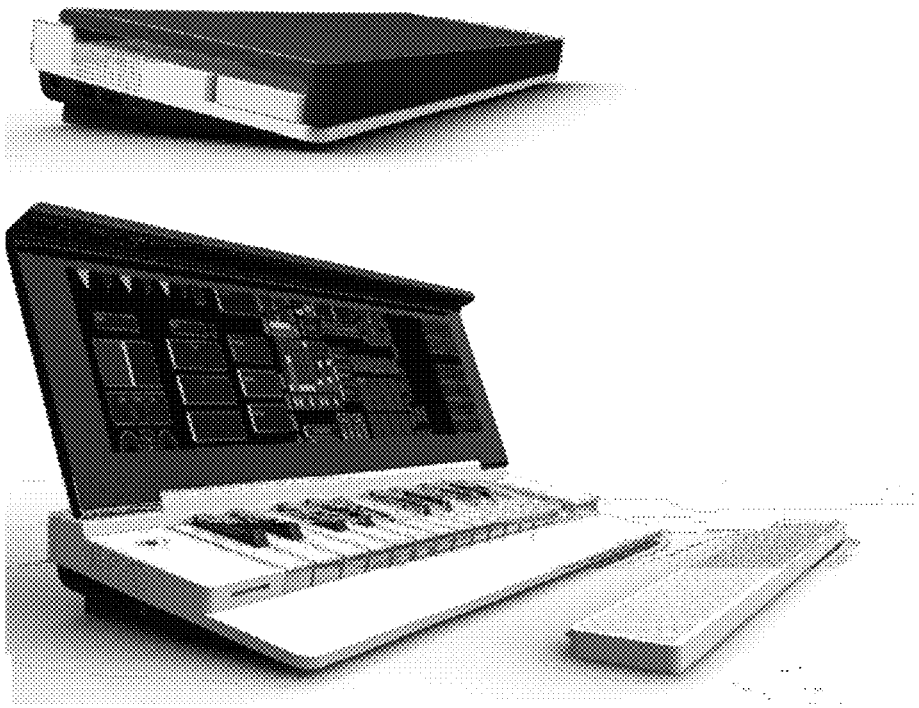


Figure 27

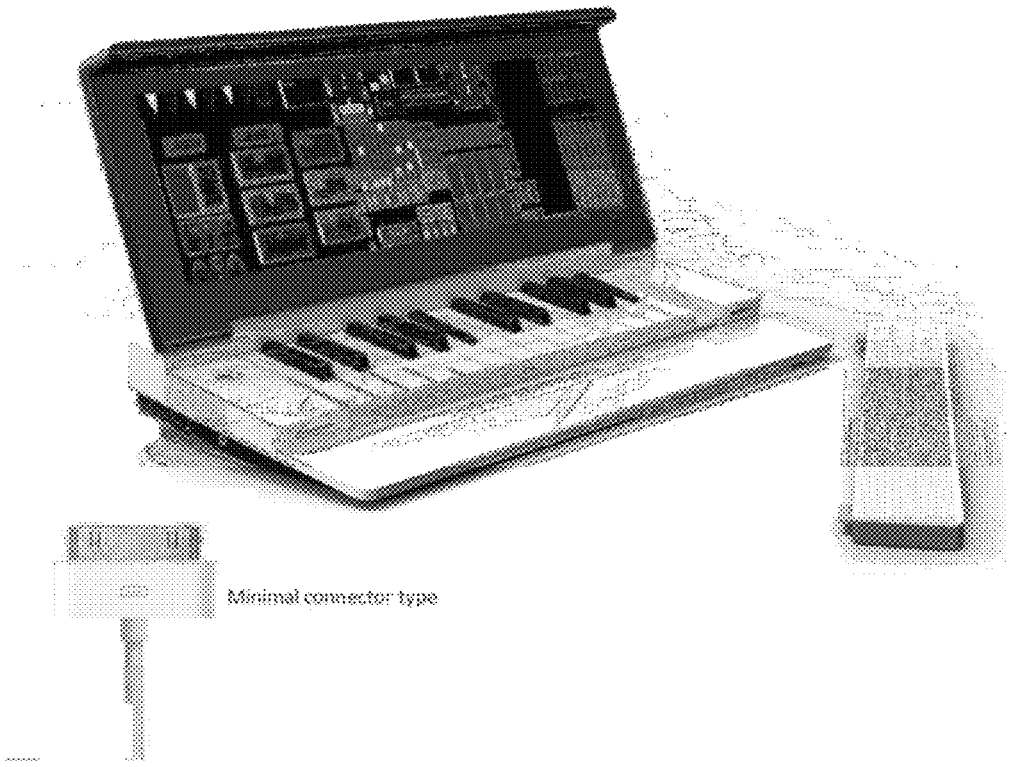


Figure 28

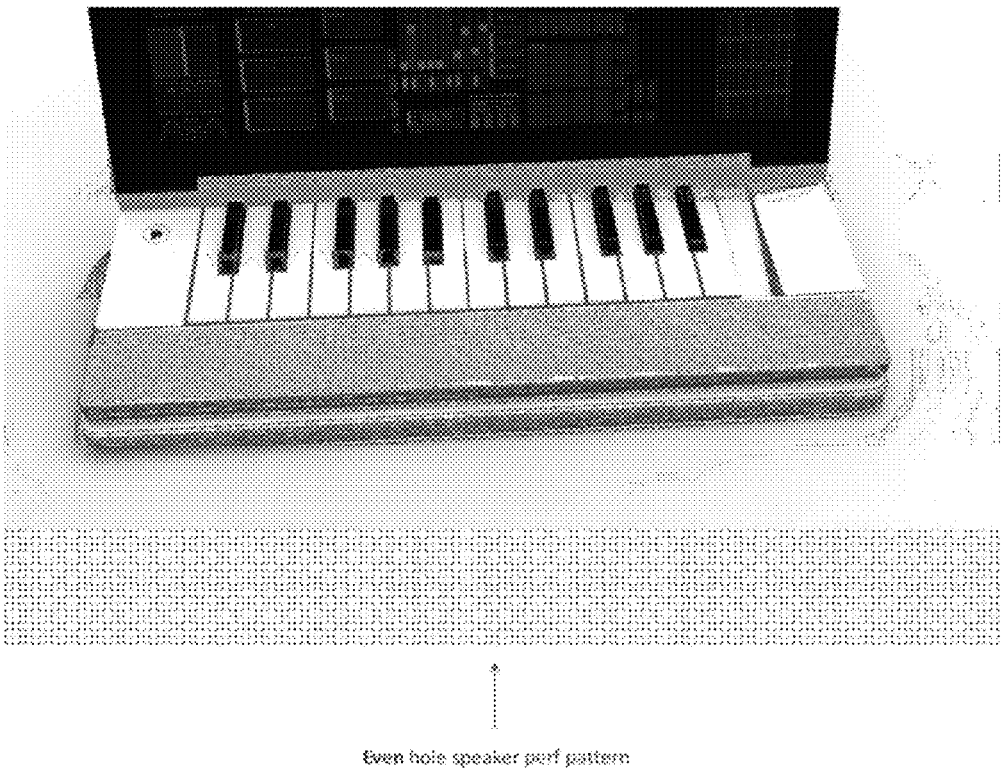


Figure 29

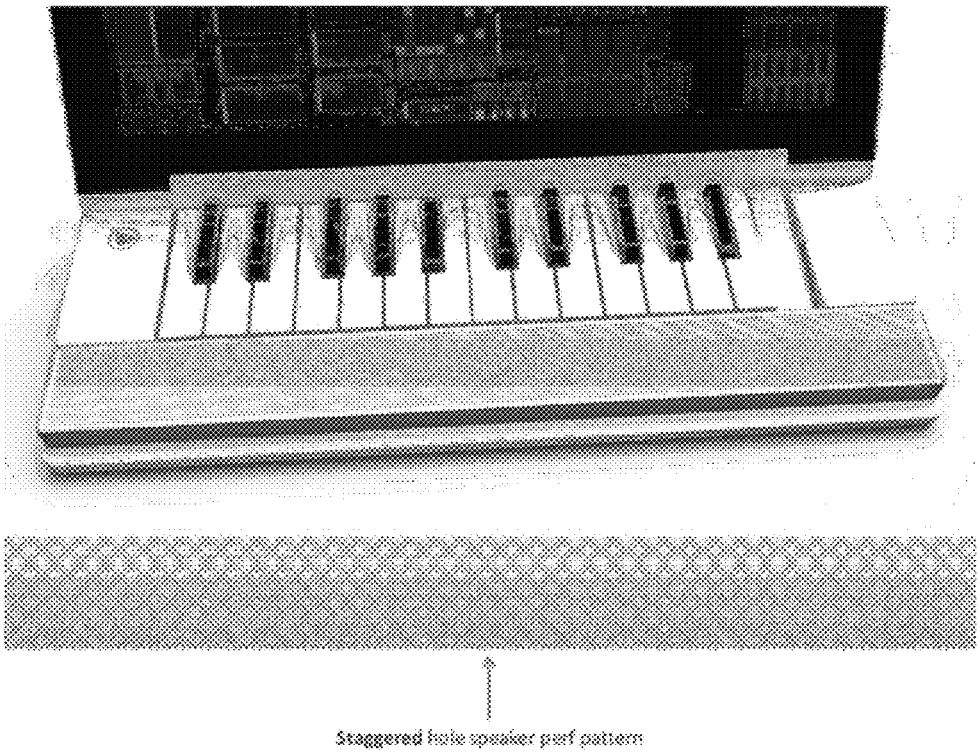


Figure 30

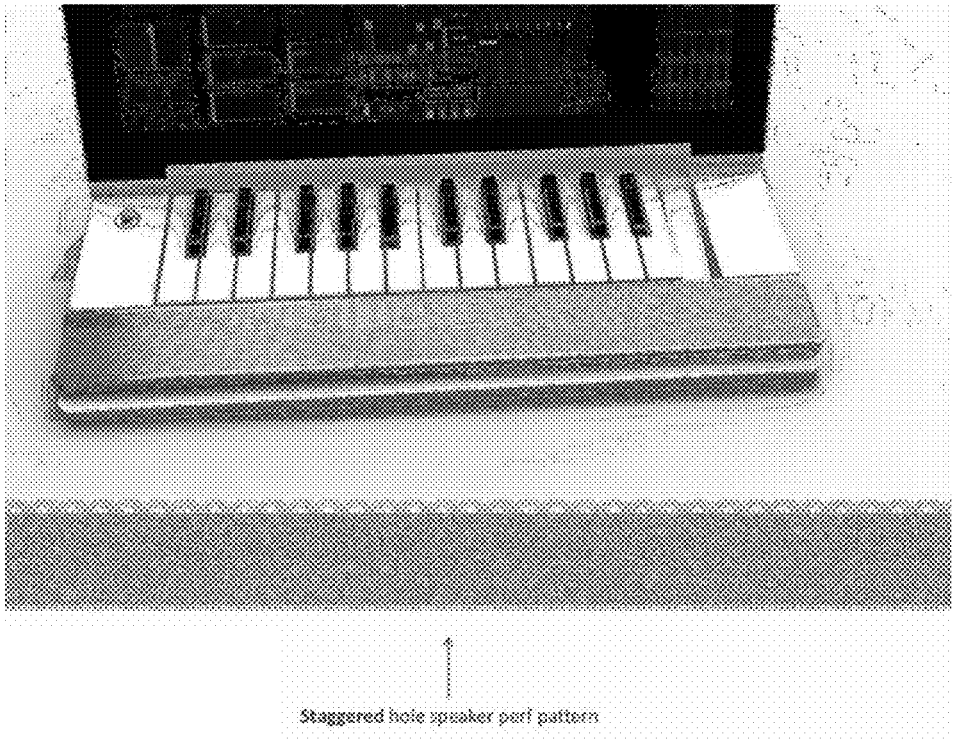


Figure 31

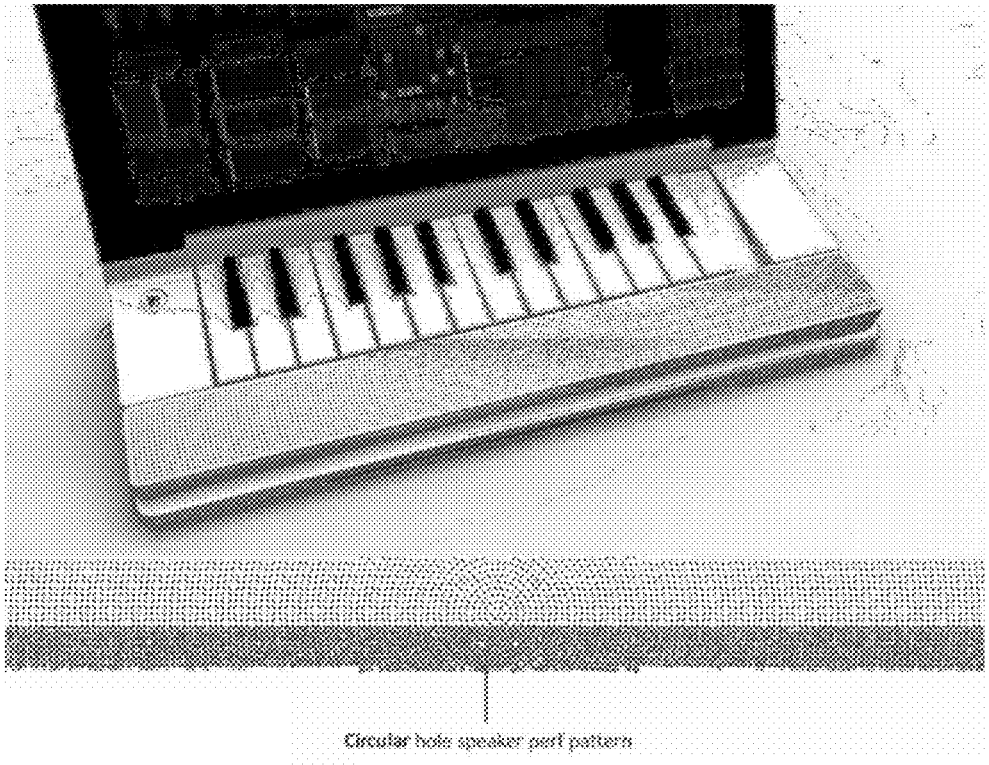


Figure 32

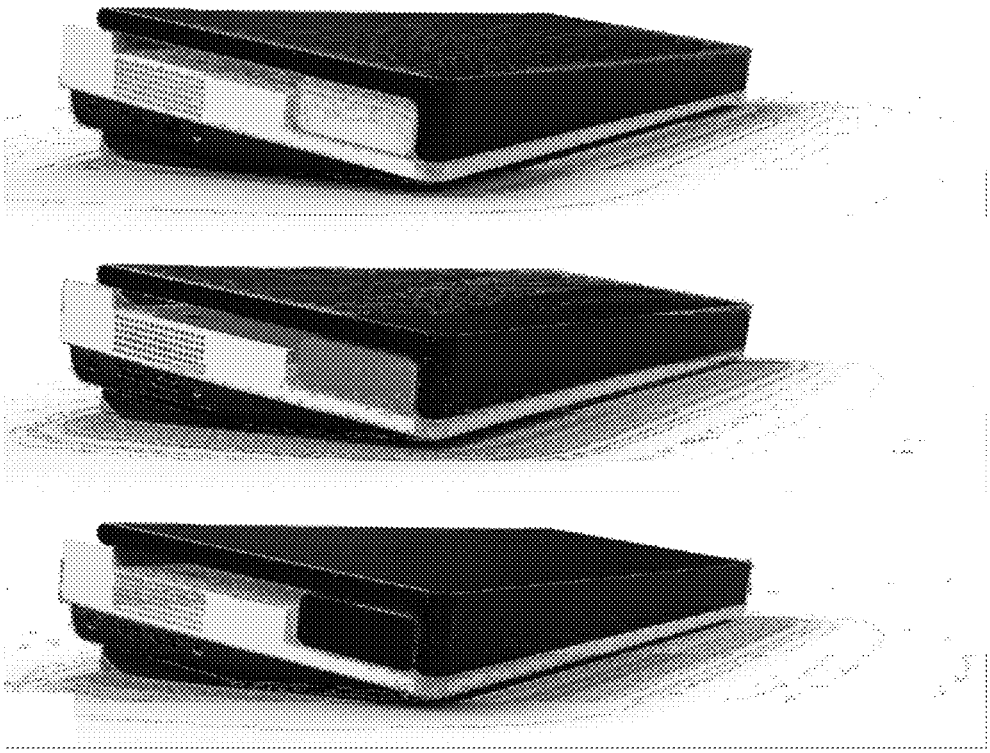


Figure 33

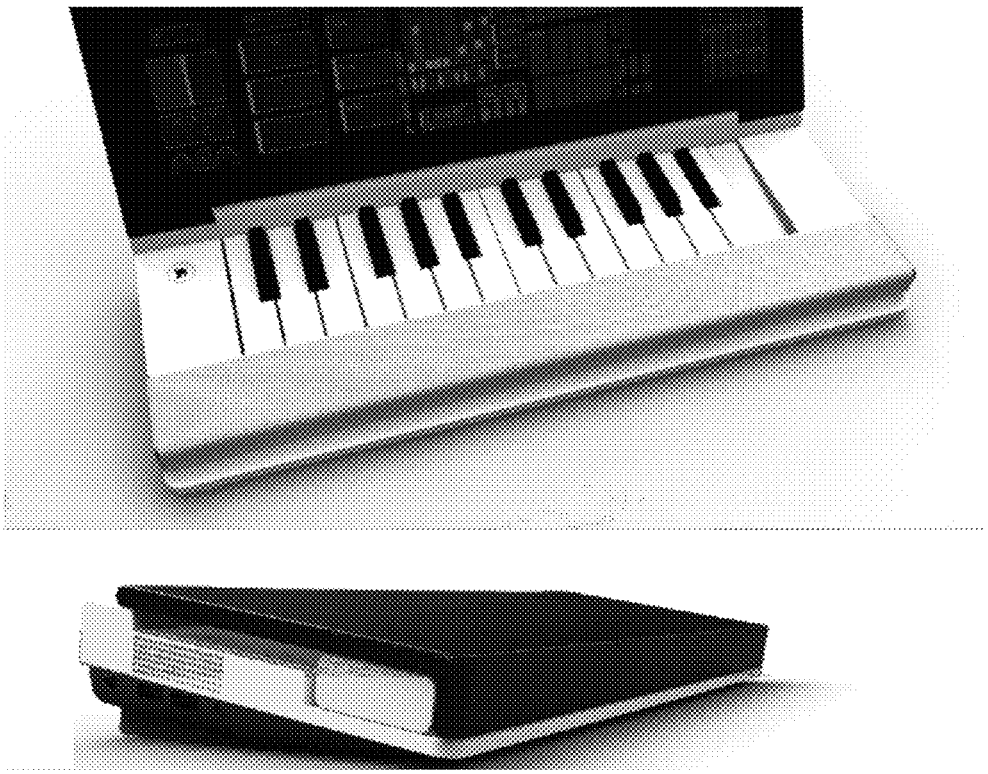


Figure 34

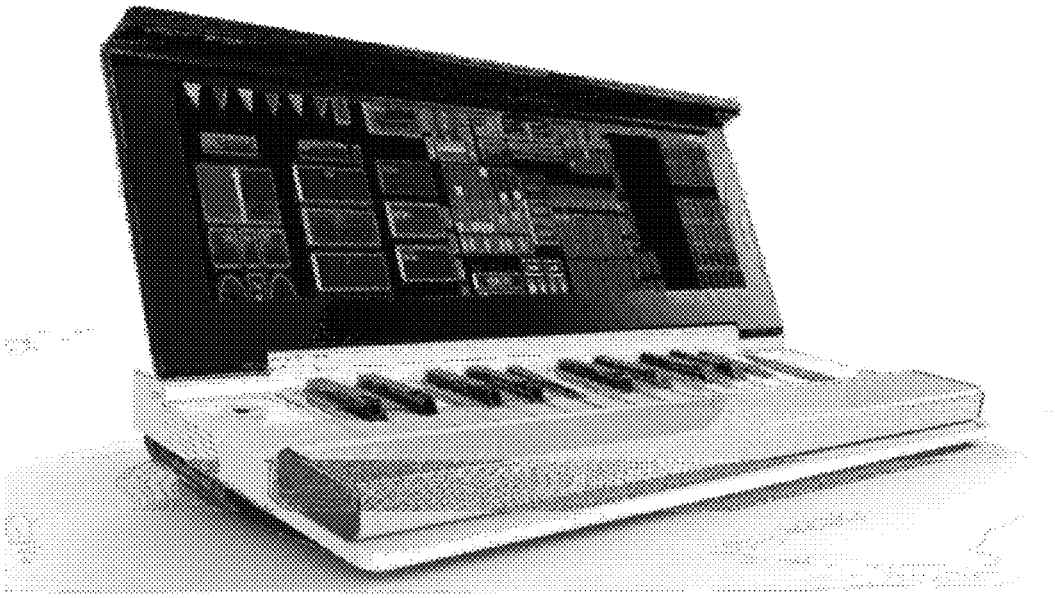


Figure 35

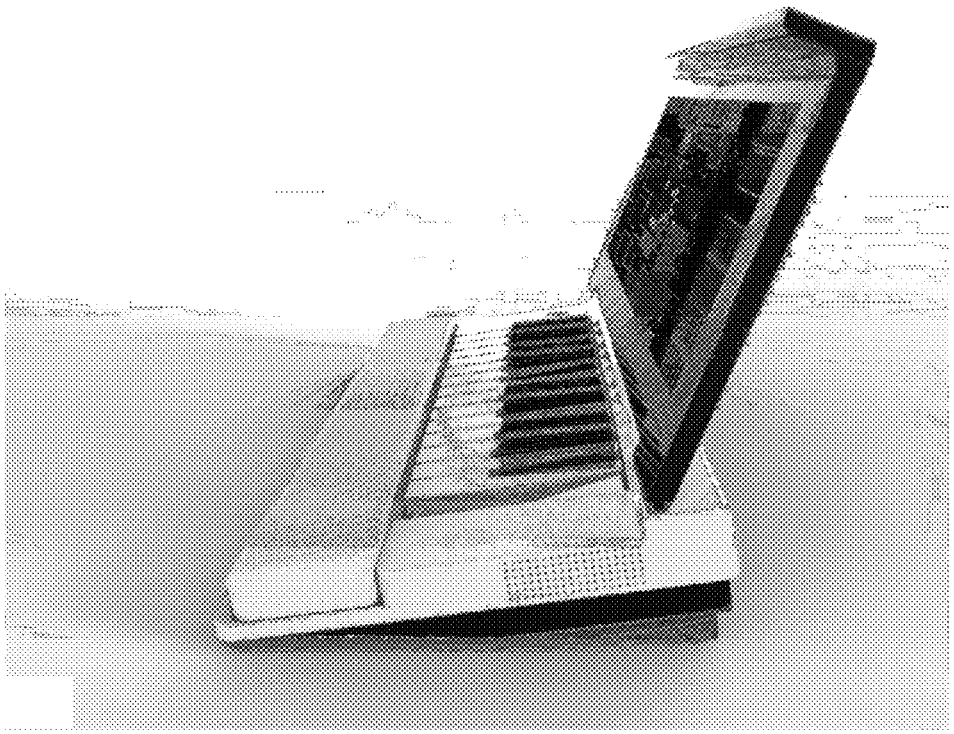
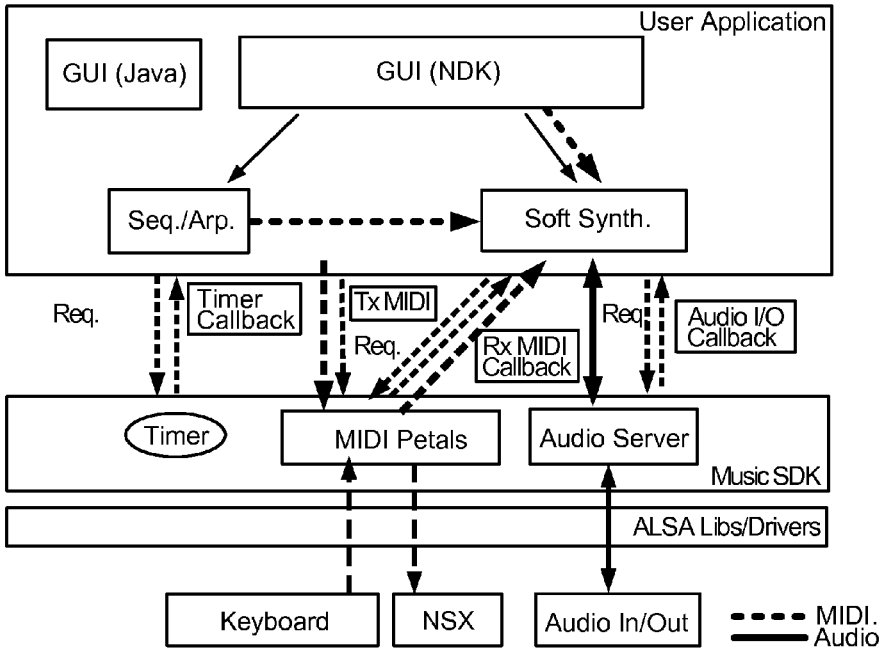


Figure 36

1. Overview



Timer Callback V1 Alpha

2. Function List

msl_ClientOpen()
msl_ProcessCallback()
msl_PortRegister()
msl_Activiate()
msl_ClientClose()
msl_RevMIDICallback()
msl_SendMidiLongMessage()
msl_SendMidiShortMessage()

3. Typedef

```
typedef int (*mslProcessCallback) (int frames, void *data);
typedef int (*mslRevMidiCallback) (msl_port_t * port, unit8_t* midi_data, int length)
```

Figure 37

4. Functions

msl_ClientOpen

	msl_client_t* msl_ClientOpen (const char* client_name)
	Sound
	client_name
	NULL:

msl_ProcessCallback

	int msl_ProcessCallback (msl_client_t* client, MslProcessCallback* callback_func)
	Audio Rendering
	client
	callback_func
	NULL:
	NULL:

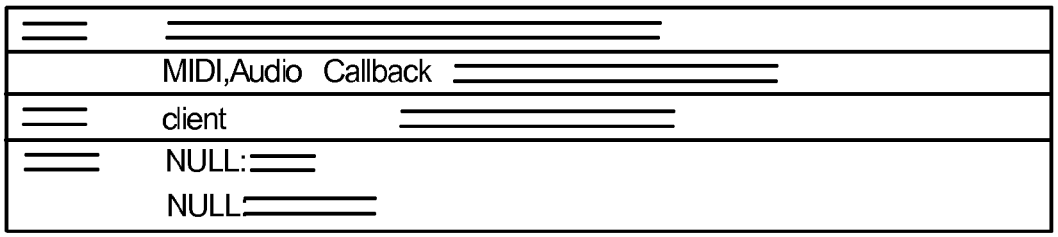
msl_PortRegister

	msl_port_t* msl_PortRegister (msl_client_t* client, const char* name, int type, int direction)	
	MIDI Port Audio Port	
	client	
	name	
	type	MslPortTypeAudio Audio MslPortTypeMidiNsx NSX Midi MslPortTypeMidiKeyBoard Midi
	direction	MslPortIsInput MslPortIsOutput
	NULL:	

msl_Activate

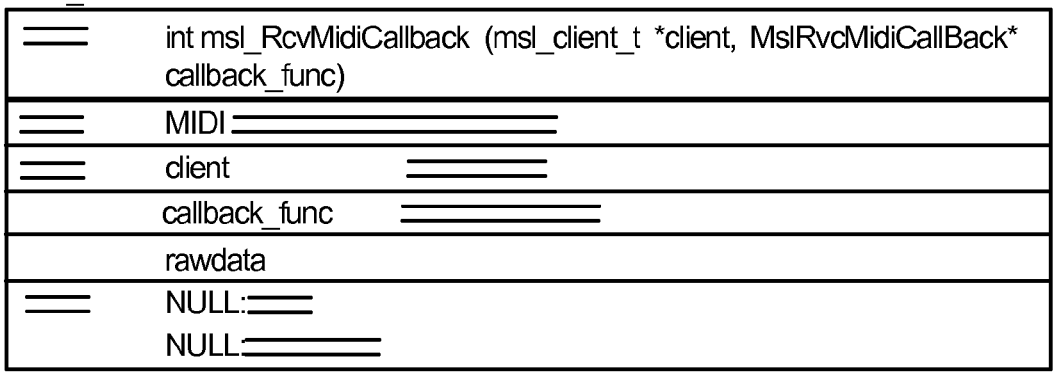
	int msl_Activate (msl_client_t *client)

Figure 38

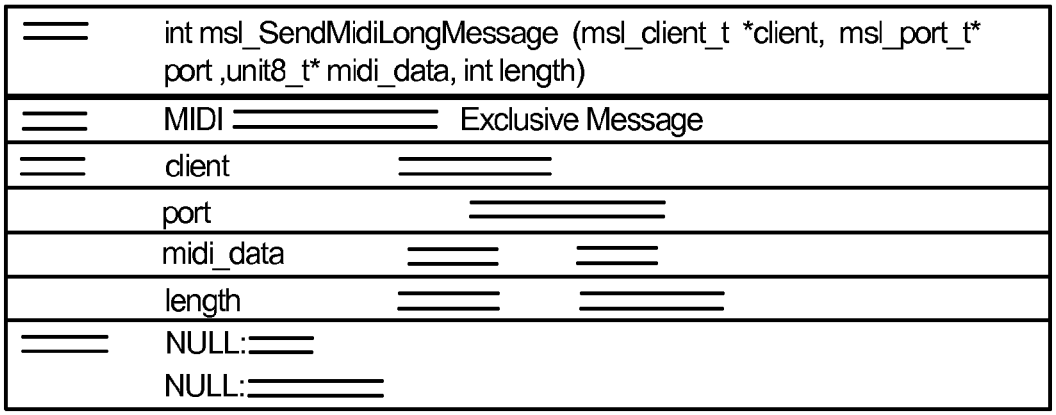


msl_ClientClose

msl_RcvMidiCallback



msl_sendMidiLongMessage



msl_sendMidiShortMessage

Figure 39

	int msl_SendMidiShortMessage (msl_client_t *client, msl_port_t* port unit32_t midi_data)
	MIDI
	client
	port MIDI Port
	midi_data LSB MIDI
	NULL:
	NULL:

5. CallbackFunction

	typedef int (*MalProcessCallback) (int nframes, void *data);
	Rendering
	nframes Rendering
	data Audio Buffer
	NULL:
	NULL:

	typedef int (*MalRcvMidiCallback) (msl_port_t * port, unit8_t* midi_data), int length)
	Midi
	port
	midi_data MIDI
	length MIDI Data
	NULL:
	NULL:

6. Pending Item

- Timer Callback
- MIDI Timestamp
-
- USB MIDI, USB Audio

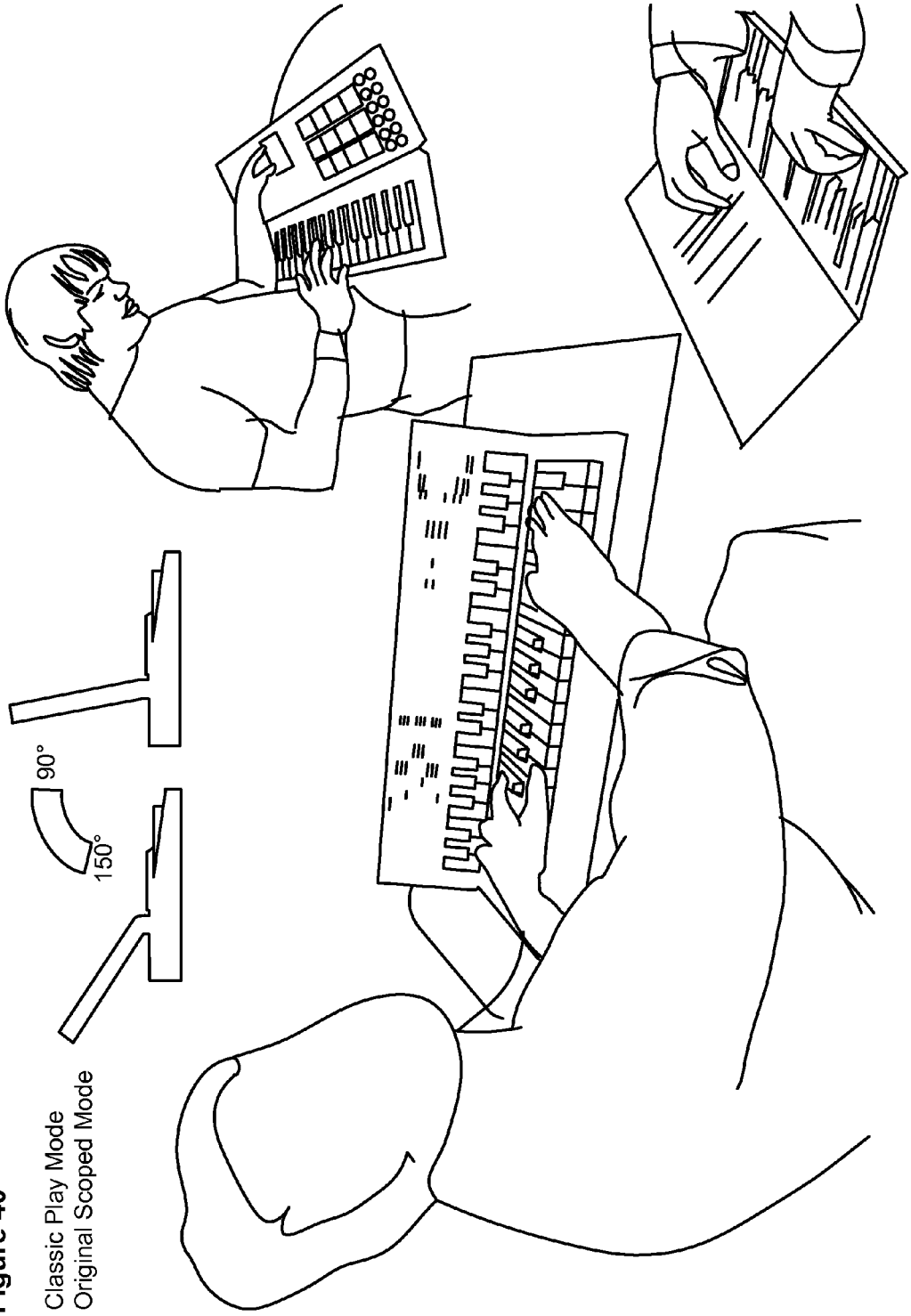
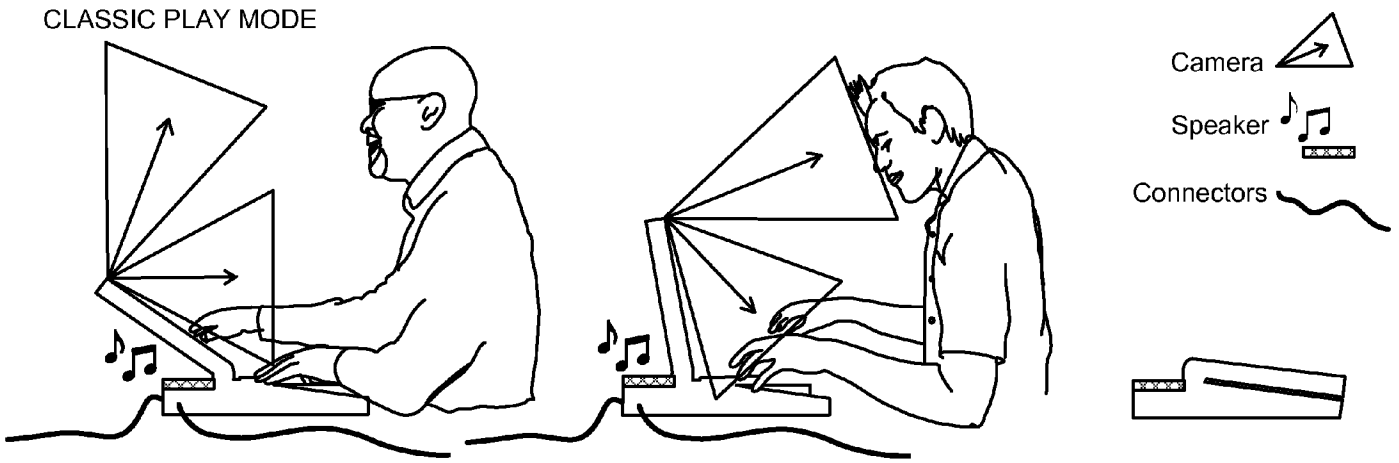


Figure 40

Classic Play Mode
Original Scoped Mode

Figure 41



PRIMARY TASKS

1. Playing (Learning, Practicing, Composing)
2. Sharing, Purchasing
3. Gaming
4. Archiving

CHALLENGES

1. Stable and robust display to resist touch
2. Matching display right against keys (accommodate Mirror/Mapping feature)
3. >speakers behind display > loud enough?

PRIMARY FEATURES

1. Mirror/Mapping feature (Display right against Keys)
2. Wide range of display angles (+5 to -60 degrees)
3. Great stability in all angles (Two handed playing, basic tough tablet functions)
4. Wide angle lenses for both cameras (Capturing hands & player)
5. High quality sound verses loud?

>>> Cameras are optimized by this usage mode

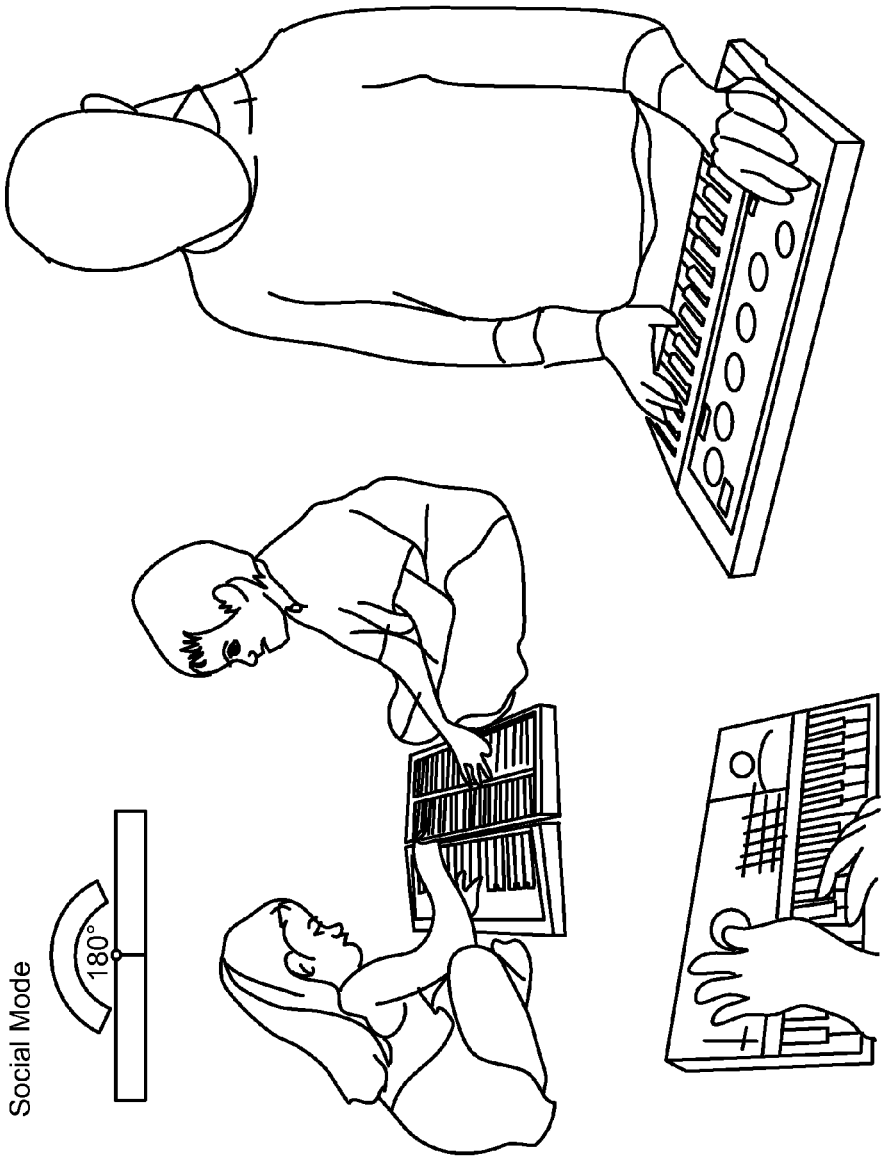
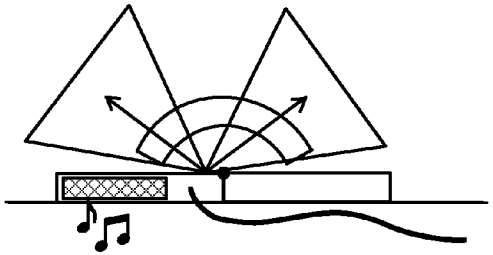


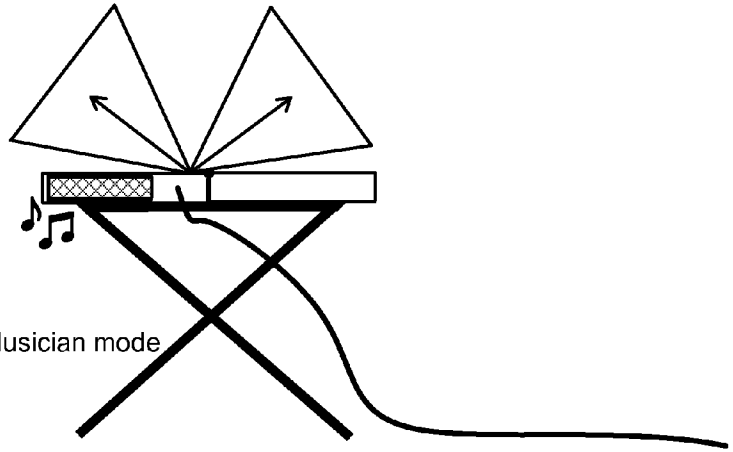
Figure 42

Figure 43

SOCIAL MODE



Social Playing Mode



Mad Musician mode

PRIMARY TASKS

1. Playing together (duet)
2. Band of Foogees in one room
3. Gaming (compete)
4. Live Musician (play both physical KB and interface with custom apps)
5. Expressing (composing)
6. Sharing

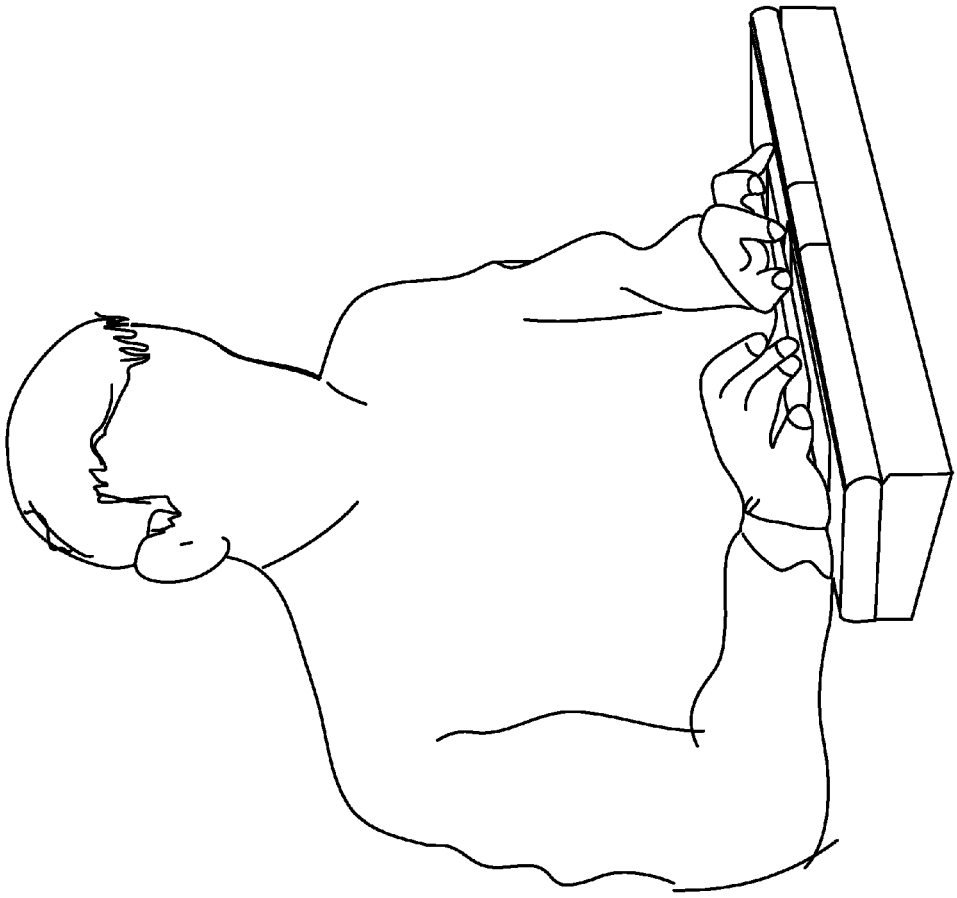
PRIMARY FEATURES

1. 180 degree open display
2. Mirror/Mapping Feature (Display right against Keys)
3. Wide Angle Lenses for both Cameras (Capturing both Players)
4. High Quality sound verses loud

CHALLENGES

1. Connector location
2. Matching display right against keys (accommodate Mirror/Mapping feature)
3. Speaker location for loud sound
4. Camera angle is not very flattering > under nose angle

>>> Social Mode drives connector location



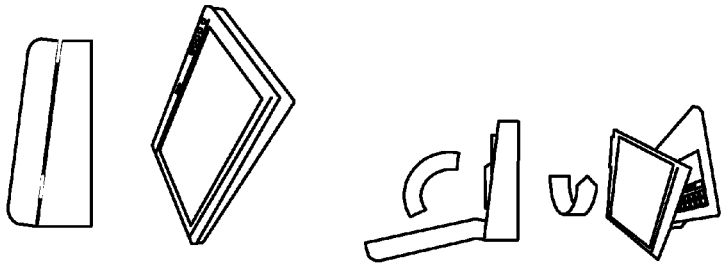
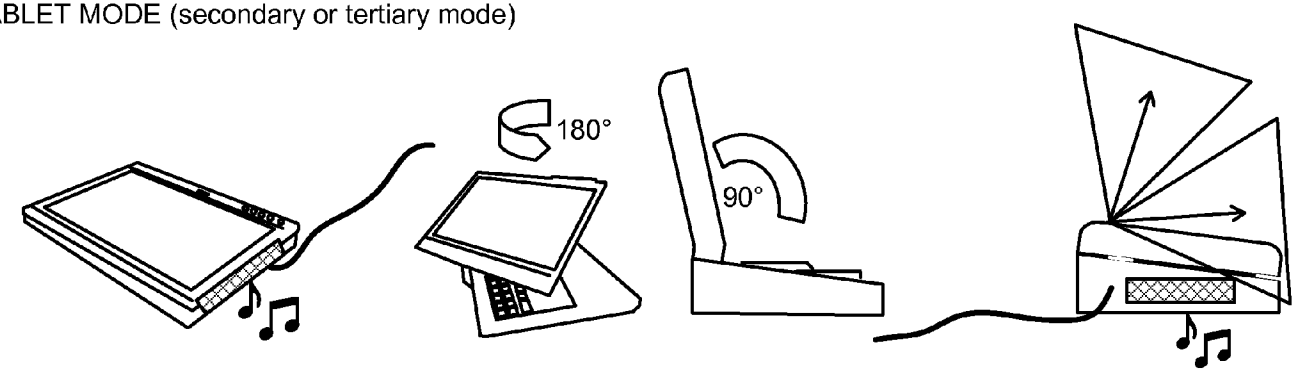


Figure 44

Figure 45

TABLET MODE (secondary or tertiary mode)



Tablet Mode

PRIMARY TASKS

1. Sharing (upload to Facebook)
2. Purchasing (buy new scores & apps, discover music)
3. Archiving
4. Standard Tablet Functions (email)

CHALLENGES

1. Complex hinging or sliding mechanism
2. Speaker location?
3. If sliding mech, cover is needed.
4. High off the table, comfortable?

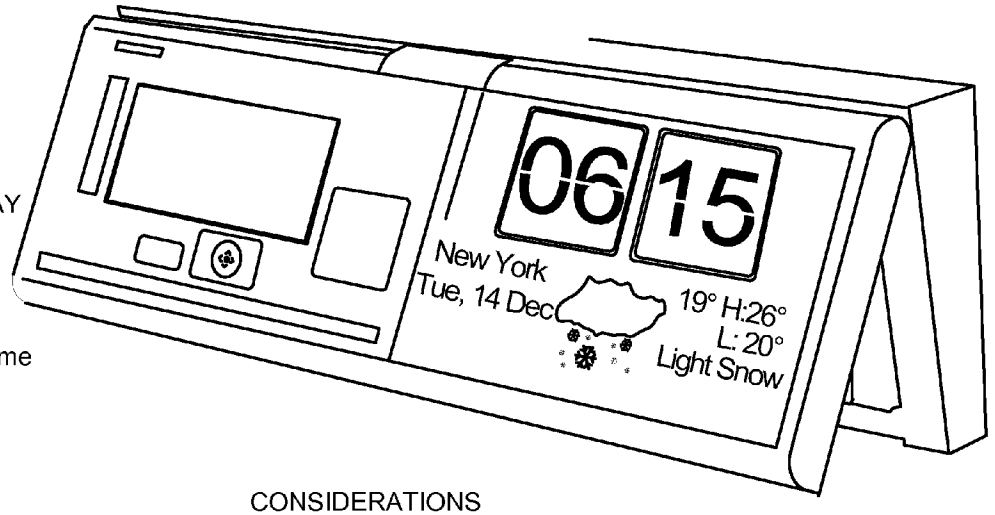
PRIMARY FEATURES

1. Tablet Functions (digital keyboard, browsing internet)
2. Descent quality sound
3. Cameras are accessible, but under chin view

>>> Tablet Mode drives possible speaker location

Figure 46

Additional configuration | TABLET + DISPLAY



PRIMARY TASKS

1. Passive consumption (listening to Pandora, streaming content)

PRIMARY FEATURES

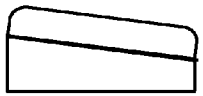
1. TV like viewing/consumption of content

CONSIDERATIONS

1. May be difficult to fold device into this configuration.

2. Mode promotes passive consumption, is this desirable?

3. Sound desirable? What kind of quality?



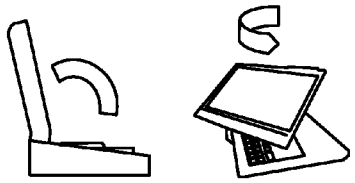
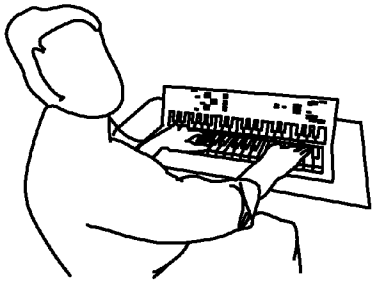


Figure 47

HARDWARE FEATURE PRIORTIZATION



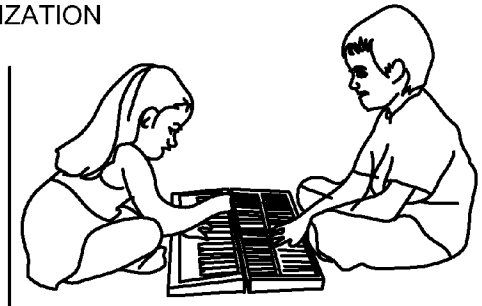
Classic

55% Usage Time

Camera location/Capture zone optimized for CLASSIC mode

CONSIDERATIONS

1. Do we need additional support (extra part?) to ensure stability of display in various angles?
2. Mirror/mapping feature creates restricted component zone, i.e. speakers must be on the sides (increases width) or behind (increases depth and potentially lowers sound quality)



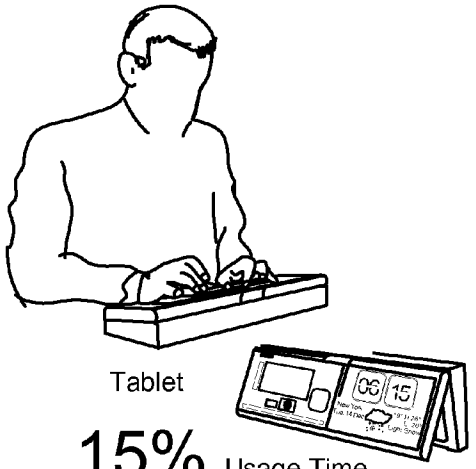
Social

30% Usage Time

Connector location driven by SOCIAL mode

CONSIDERATIONS

1. How best to make use of cameras
2. Mode requires loud/high quality sound.
3. Mirror/mapping feature wants to be maintained in this mode.



Tablet

15% Usage Time

Speaker location driven by Tablet mode

CONSIDERATIONS

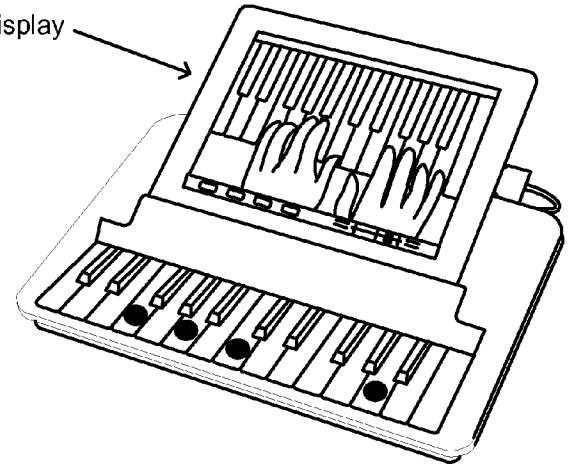
1. Do we need speakers in this mode, or are headphones only sufficient?
2. Do we need cameras in this mode?
3, Mode increases complexity of hinge or sliding mechanism.
4. Ergonomics is sensitive to stacked up height.

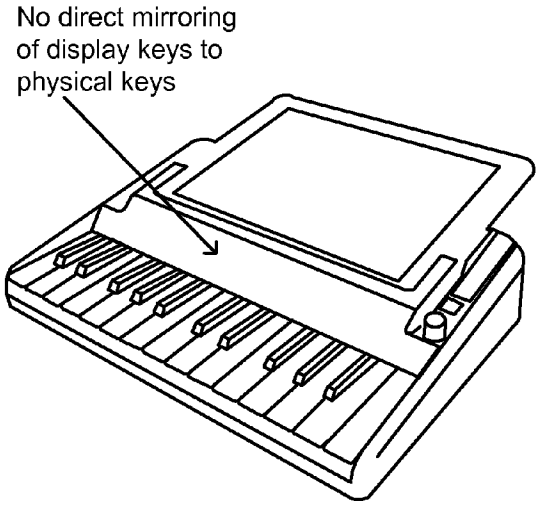
Figure 48

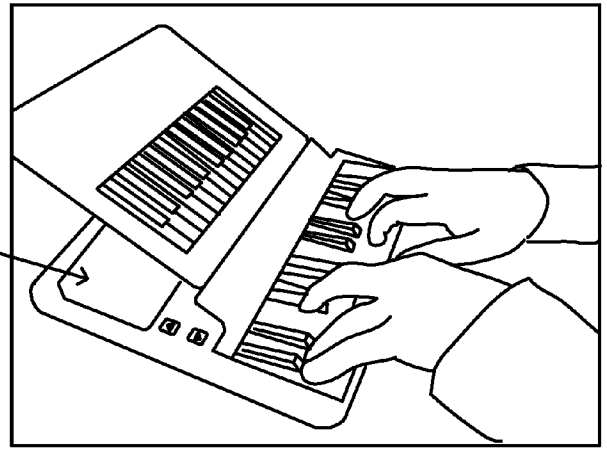
iPad Music Accessory Keyboard

The **Ion Piano 2 Go** is a new dock that transforms your iPod or iPad into a music making workstation.

Features:
-Keyboard and piano performance app for iPod or iPad
-25 note mini keypad
-Velocity-sensitive keys
-Includes free App download with four different sounds to play
-Everything you need to practice, perform and write music
-Powered by batteries or AC adaptor







PORTABLE PIANO KEYBOARD COMPUTER

CROSS REFERENCES TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Patent Application Ser. No. 61/609,196, entitled "Portable Piano Keyboard Computer", filed on Mar. 9, 2012, which is hereby incorporated by reference as if set forth in full in this application for all purposes.

FIELD OF THE INVENTION

This application is related in general to computer systems and more specifically to a computer system that uses a piano-type keyboard and display screen along with additional controls to provide music related applications, utilities and other functionality.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** illustrates a piano keyboard with associated display screen.

FIG. **2** shows a display screen overlaying the keys.

FIGS. **3-11** illustrate a piano keyboard with associated display screen.

FIG. **12** shows a display screen overlaying the keys in two different modes.

FIGS. **13-14** show how a speaker and associated functionality may be included.

FIG. **15** shows one usage scenario.

FIGS. **16-22** show function keys for Half Island or Full Island configurations

FIGS. **23-27** show the speaker dock in various low profile configurations

FIGS. **28-31** illustrate perforations patterns for the speaker dock

FIGS. **32-35** show the speaker dock in various high profile configurations

FIGS. **36-39** show example music SDK V1 API specifications

FIGS. **40-48** illustrate various usage scenarios and corresponding system configurations.

DESCRIPTION OF EMBODIMENTS

A portable computing system that includes a piano-style keyboard provides a system platform for musical applications. In a music tutorial application, a user follows the display of written musical notes as the music is played and each played note is indicated at a first tempo. A visual indicator above each key is turned on when that particular key should be played in order to play along with the progressing music. When the user sees the visual indicator then the user should press the key in order to play a correct note. A tempo or speed controller is provided so that the user can adjust the playback faster or slower in order to have less or more time to select the proper piano key to press.

In a particular embodiment, the tempo controller is a dedicated physical slider at the left side of the piano keyboard. In other embodiments a different dedicated controller can be used. Or the tempo controller can be a soft controller that is displayed on a display screen. The soft controller can be manipulated with a touchscreen, touchpad; mouse, trackball, pointing stick or other pointing device, voice commands, etc.

In a particular embodiment each note that is supposed to be played next is shown with an image that is positioned on the display screen. The display screen abuts next to or is adjacent to or otherwise in proximity to the piano keys. The display screen extends to substantially the full width of the piano keyboard so that an image cue to press a key can be shown immediately above the correct key to be played. In other embodiments, other keyboard/display arrangements are possible such as by having the display positioned below (i.e., between the user and the keyboard), using a projection display, not having the display run the full length of the keyboard, etc. Other variations are possible. See FIGS. **1-11**. See, also, FIG. **12** showing the screen overlaying the keys for purposes of illustrating the correspondence of the graphics on the screen to the keys. The upper portion (A) of FIG. **12** shows a Traditional Learning Mode, which has the same learning functionality as GarageBand™ but improved overall user experience, with a multi-touch user interface and a cloud-based information display, such as tweets and Facebook™ updates from the user's own social graphs. The lower portion (B) of FIG. **12** shows an Interactive Learning or Game Mode, which has similar functionality as that of FingerPiano™ for IOS. However, using the Tempo Slider 1320 will help the user to slow down the learning pace, the multi-touch user interface helping the user to navigate the system easily while focusing on practice.

In a particular embodiment, the image cues move vertically from a point farther away from the keys to a point close to the keys and then disappear. When the image cue is at a point close to its respective key then that key is supposed to be pressed or played by the user. See FIGS. **1-11**. See, also, FIG. **12** showing the screen overlaying the keys only for purposes of illustrating the correspondence of the graphics on the screen to the keys.

Another embodiment provides music visualization. When a key is pressed on the piano keyboard a visual effect takes place (1) in proximity to the key and (2) in association with the note (or tone) being played. For example, a particular visualization creates colored bubbles that emanate slowly from a point vertically in-line with the key being played. The characteristics of the bubbles can correspond to the characteristics of the note played. For example, the force and duration of the keypress can cause the bubbles to move more rapidly or to be larger, respectively. In a preferred embodiment, some characteristics of the visual image such as the color and starting position are always the same for a same key being played. In other embodiments many other variations are possible. Different shapes and animations can be used. The visualizations need not always match up with a given key.

In another embodiment, the piano keyboard computer can act as a controller for other musical devices. On-screen soft controllers on the piano keyboard computer's display screen can be used to control functions on other devices such as a music application running on another computer. Functions such as modulation, velocity and pitch bend can be assigned to a soft controller in the piano keyboard computer and controlled via a wired or wireless protocol (e.g., Bluetooth, wifi, etc.).

Another embodiment includes a docking area below the piano keys. This is a relatively open area so that additional hardware devices such as a speaker or speakers, hardware controllers (e.g., sliders, buttons, modulation wheel, etc.) can be placed on or attached to the piano keyboard computer. In one embodiment the added devices can electrically connect to the piano keyboard computer by hardwired connectors. In another embodiment the communication between the added devices and the piano keyboard computer can be by wireless protocol. See FIGS. **13-35**.

Yet another embodiment provides a Software Development Toolkit (SDK) and Application Program Interface (API) that allows different systems and processes to communicate while also maintaining very low latency (i.e., fast response and processing times). Such low latency is often critical in music applications where small delays can affect the integrity of playing a performance or the art of creating a composition. Various functions of the SDK and API are shown including the use of callback routines to handle resource and processing requests. See FIGS. **36-40**.

A further understanding of the nature and the advantages of particular embodiments disclosed herein may be realized by reference to the remaining portions of the specification and drawings. FIGS. **40-48** in particular illustrate various usage scenarios and corresponding system configurations.

Although the description has been described with respect to particular embodiments thereof, these particular embodiments are merely illustrative, and not restrictive of the invention, the scope of which is to be determined by the claims.

Any suitable programming language can be used to implement the routines of particular embodiments including C, C++, Java, assembly language, etc. Different programming techniques can be employed such as procedural or object oriented. The routines can execute on a single processing device or multiple processors. Although the steps, operations, or computations may be presented in a specific order, this order may be changed in different particular embodiments. In some particular embodiments, multiple steps shown as sequential in this specification can be performed at the same time.

Particular embodiments may be implemented in a computer-readable storage medium for use by or in connection with the instruction execution system, apparatus, system, or device. Particular embodiments can be implemented in the form of control logic in software or hardware or a combination of both. The control logic, when executed by one or more processors, may be operable to perform that which is described in particular embodiments.

Particular embodiments may be implemented by using a programmed general purpose digital computer, by using application specific integrated circuits, programmable logic devices, field programmable gate arrays, optical, chemical, biological, quantum or nanoengineered systems, components and mechanisms may be used. In general, the functions of particular embodiments can be achieved by any means as is known in the art. Distributed, networked systems, components, and/or circuits can be used. Communication, or transfer, of data may be wired, wireless, or by any other means.

It will also be appreciated that one or more of the elements depicted in the drawings/figures can also be implemented in a more separated or integrated manner, or even removed or rendered as inoperable in certain cases, as is useful in accordance with a particular application. It is also within the spirit and scope to implement a program or code that can be stored in a machine-readable medium to permit a computer to perform any of the methods described above.

A "processor" includes any suitable hardware and/or software system, mechanism or component that processes data, signals or other information. A processor can include a system with a general-purpose central processing unit, multiple processing units, dedicated circuitry for achieving functionality, or other systems. Processing need not be limited to a geographic location, or have temporal limitations. For example, a processor can perform its functions in "real time," "offline," in a "batch mode," etc. Portions of processing can be performed at different times and at different locations, by different (or the same) processing systems. A computer may be any processor in communication with a memory. The memory may be any suitable processor-readable storage medium, such as random-access memory (RAM), read-only memory (ROM), magnetic or optical disk, or other tangible media suitable for storing instructions for execution by the processor.

As used in the description herein and throughout the claims that follow, "a", "an", and "the" includes plural references unless the context clearly dictates otherwise. Also, as used in the description herein and throughout the claims that follow, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

Thus, while particular embodiments have been described herein, latitudes of modification, various changes, and substitutions are intended in the foregoing disclosures, and it will be appreciated that in some instances some features of particular embodiments will be employed without a corresponding use of other features without departing from the scope and spirit as set forth. Therefore, many modifications may be made to adapt a particular situation or material to the essential scope and spirit.

We claim:

1. A method for providing a music tutorial, the method executing on a computer system including a display screen adjacent to a piano-type keyboard, the method comprising the following acts performed by one or more digital processors:

playing back a musical composition;

displaying an image cue on the display screen to prompt a user to press a key on the keyboard;

determining if the prompted key has been pressed; and

in response to the determining, displaying a visual effect on the display screen, wherein a first visual characteristic of the displayed visual effect is independent of any characteristic of the pressing other than the identity of the pressed key.

2. A method for providing a music visualization, the method executing on a computer system including a display screen adjacent to a piano-type keyboard, the method comprising the following acts performed by one or more digital processors:

determining when a key on the piano-type keyboard has been pressed; and

in response to the determining, displaying on the display screen a visualization associated with the pressed key, wherein the visualization is displayed in spatial association with the pressed key, and wherein a visual characteristic of the visualization is independent of any characteristic of the pressing other than the identity of the pressed key.

3. The method of claim **2**, wherein the spatial association includes displaying the visualization above, and in vertical alignment with, the pressed key.

4. An apparatus comprising:

a piano-type keyboard having a substantially flat top surface;

a display screen adjacent to and above the keyboard;

one or more processors coupled to the keyboard and to the display screen;

a substantially flat area adjacent to and below the top surface of the keyboard for placing an additional device comprising at least one of an audio speaker and an audio controller; and

a processor-readable storage device including one or more instructions executable by the processor for communicating with the additional device;

wherein the additional device does not comprise the display screen.

5. The method of claim 1, wherein the visual effect is displayed in spatial association with the pressed key.

6. The method of claim 1, wherein a second visible characteristic of the visual effect is determined by an audible characteristic of the pressed key.

7. The method of claim 6, wherein one of the first visible characteristic and the second visible characteristic is uniquely associated with the pressed key.

8. The method of claim 6, wherein the audible characteristic of the pressed key comprises one of the force and duration of the pressure exerted by the user on the pressed key.

9. The method of claim 8, wherein the second visible characteristic comprises a rate of motion of the visual effect across the display screen.

10. The method of claim 2, wherein a second visible characteristic of the visual effect is determined by an audible characteristic of the pressed key.

11. The method of claim 10, wherein the second visible characteristic is uniquely associated with the pressed key.

12. The method of claim 10, wherein the audible characteristic of the pressed key comprises one of the force and duration of the pressure exerted by the user on the pressed key.

13. The method of claim 12, wherein the second visible characteristic comprises a rate of motion of the visual effect across the display screen.

14. The apparatus of claim 4, wherein the additional device comprises a speaker.

15. The apparatus of claim 4, wherein the additional device comprises a hardware controller.

* * * * *